AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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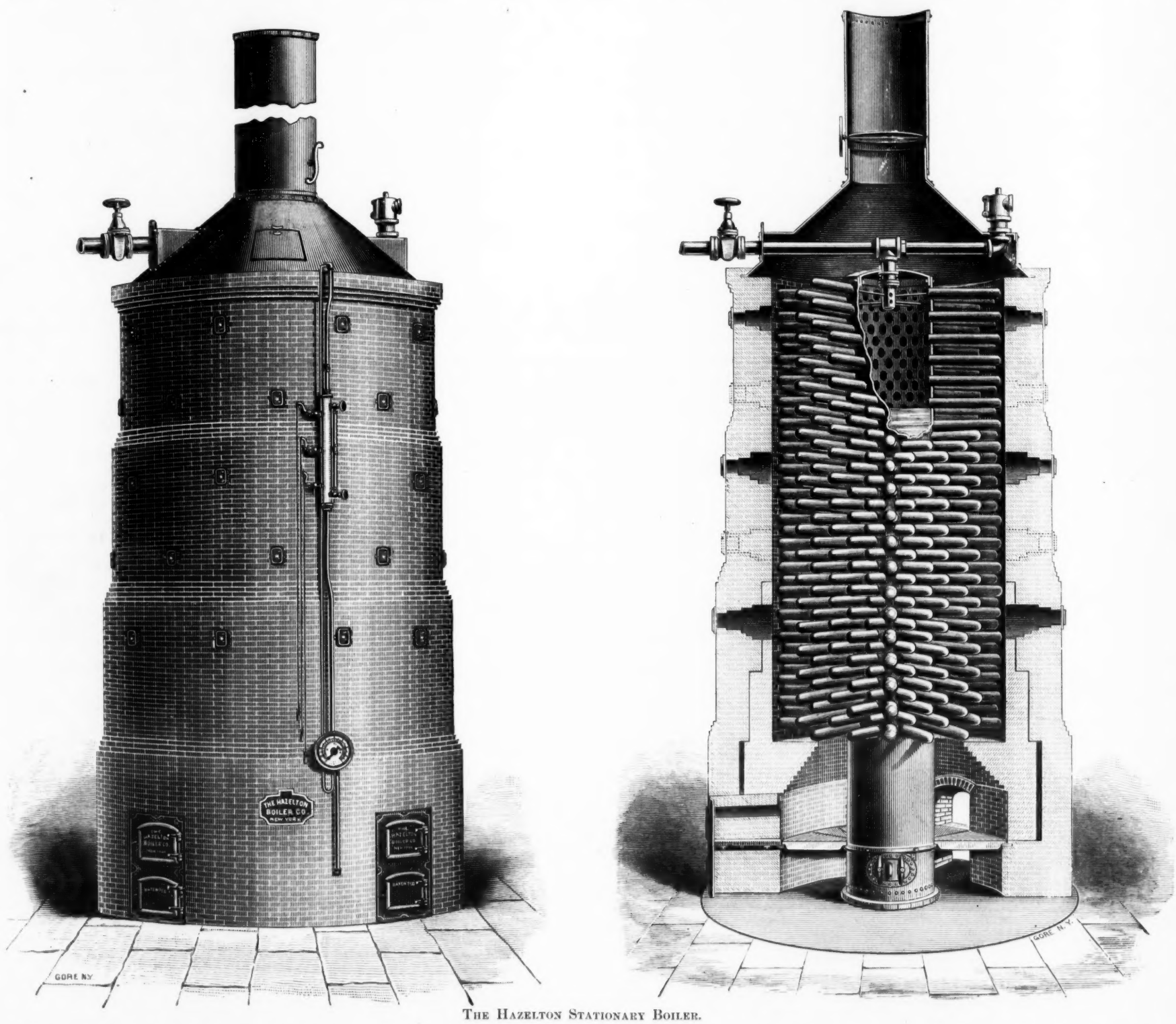
The Hazelton Stationary Boiler.

The engravings which we present herewith represent this boiler as recently improved and placed on the market by the Hazelton Boiler Company, of New York. It is of the water tube type. Its construction may be understood by referring to the engravings.



THE HAZELTON STATIONARY BOILER.

Referring to these, it will be seen the essential features of this boiler are a vertical stand pipe, with radial tubes. The stand pipe rests upon a circular foundation plate, which is placed upon a brick foundation, raised a little above the general foundation to prevent the water in ash pit from coming in contact with the metal. The stand pipe is not fastened to foundation, being left free to expand and contract.

That part of the stand pipe that extends below the grate forms a mud drum, which is fitted with a manhole for entering the stand pipe. The circulation of water brings the mud and dirt into the mud drum, where it is blown off or otherwise removed.

The diameter, length and number of the radial tubes depend upon the size of boiler. The inner end of each tube is open, while the outer end is closed, so as to form a hemispherical end; in the process of closing this end is thickened and thereby strengthened. The inner ends of the tubes are expanded into the stand pipe; it will be seen that the outer ends of the tubes being free there can be no strain whatever from expansion.

A wrought-iron pipe is riveted to the under side of the top head of stand pipe so as to secure abundant thread for steam pipe. A nipple is screwed in from the outside, the lower end having a long thread extending two or three inches below the head. At the upper end of this nipple a tee is connected; from an outlet of this tee the steam pipe extends horizontally to the outer line of brickwork, while another pipe extends in the opposite direction, to which a pop safety valve is connected.

At the lower end of the nipple referred to (inside the stand pipe), a vertical pipe is connected by a flange union. Into this vertical pipe are screwed a series of small horizontal pipes, open at both ends; these extend outwardly and into the uppermost radial tubes. These upper tubes are steam drying tubes, and by this means it is intended to supply the steam pipe with dry steam.

The water columns are of different lengths, to suit the various sizes of boilers. They are made of extra heavy, lap welded, wrought-iron pipe, into which three spring gauge cocks are tapped, and a water gauge is attached, having automatic self-closing valves to meet the contingency of a broken gauge glass. In the longest water columns, wherein excessive length of glass would be undesirable, it is in two equal pieces, joined at center by a bracket attached to column. The steam pipe of column is connected to top head of stand pipe, and the water pipe connected to stand pipe beneath, and as close to grate bars as is possible, so as not to interfere with the easy removal of ashes from ash pit. A three-way valve is placed

on water pipe of column to blow it down when necessary, and also to free horizontal water pipe connecting it to stand pipe, and the water discharged into ash pit.

The steam and water pipes, respectively, have a brass union for the ready connection of water column to boiler.

The steam gauge is connected to a branch outlet in steam pipe of water column.

The feed pipe is connected to stand pipe below the grate bars.

The blow-off pipe is also connected to stand pipe, but has an extension within the stand pipe, which reaches nearly to the bottom head; to the other end of pipe, outside of brickwork, a blow-off pipe is connected.

The grate surface is circular in form, and in the larger boilers extends entirely around the stand pipe. The smaller boilers require less, and the grate surface extends only a portion of the distance. The grate bars at their inner ends rest upon a wrought-iron ring, supported by wrought-iron brackets riveted to stand pipe, and the outer ends are supported by cast-iron plates resting upon a projection of brickwork.

The deflecting plates are of wrought-iron, and vary in width, with the length of the radial tubes. They are placed horizontally around the inside circle of brickwork, close to same, and serve to direct the currents of heat toward the stand pipe, where the radial tubes present less free draft space than at their outer ends.

The manufacturers of this boiler claim that in its construction nothing but the best material is used, and that all fittings are made extra heavy to withstand the pressure.

The essential parts, it is claimed, are of small diameter, thus insuring safety; there is perfect circulation of water and great variations in water level will not endanger the boiler.

There is very slight radiation of heat from the brickwork enclosure, which is simple in construction, and requires no more brick than for other types of boilers. All the heating surface is effective, and priming is avoided. It is made entirely of wrought-iron, except the manhole plate, grate bars, and door fronts, and is placed in brickwork enclosure in such a manner that it can freely expand and contract in every part without strain, therefore there can be no leakage due to unequal expansion and contraction. It can be entered through manhole in lower end of stand pipe, and every square inch of its interior examined, and all dust deposits from the fire removed from its exterior, by introducing a steam hose, having a rose-head nozzle, through sight doors in brickwork enclosure.

No brick chimneys required, as the brickwork of boiler from level of grate bars upwards, forms the largest portion of necessary stack and a single iron stack of sufficient length to extend about two feet above highest point in roof over boiler room, or an adjoining loftier building, to meet the requirements of natural draft, is all this boiler demands.

The radial tubes being at a right angle to the currents of heat, and placed in stand pipe in such a manner as to cause these currents to take a tortuous lateral course in their exit from combustion chamber, the heat is very thoroughly utilized and the temperature of the escaping gases reduced to the minimum.

Owing to the peculiar construction of the deflecting furnace, the gases are ignited and consumed, and the calorific value of the fuel very thoroughly utilized, and this furnace serves to direct the currents of heat toward the stand pipe, where the radial tubes are nearer to each other than at their outer ends, and the deflecting plates above assist in maintaining this direct upward draft, thereby bringing the heat in contact with the large volume of water in the stand pipe and greatly accelerating the circulation in the radial tubes.

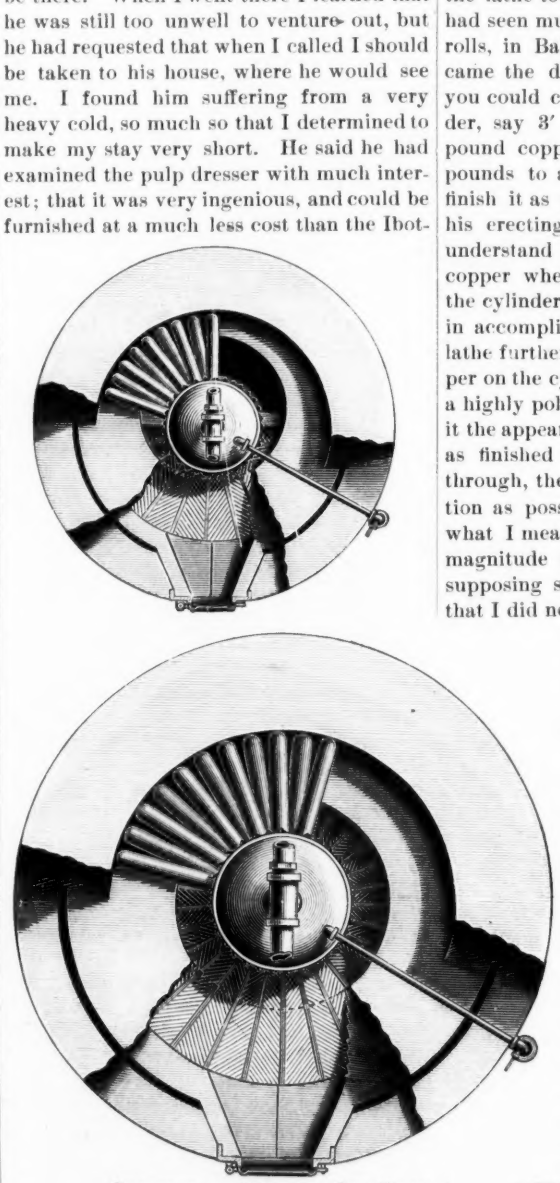
We regret to state that by a vote the Pacific Mills Library and Relief Association, at Lawrence, Mass., has ceased to exist.

Early Engineering Reminiscences.

By George Escol Sellers.

Thirty-second Paper.

A few days after the pulp dresser was sent to Mr. Donkin's shops I received a note from him, saying he had been quite unwell and had not been to the shops for a couple of days, but he had examined the pulp dresser and would like to see me at his works, naming a time when he hoped to be able to be there. When I went there I learned that he was still too unwell to venture out, but he had requested that when I called I should be taken to his house, where he would see me. I found him suffering from a very heavy cold, so much so that I determined to make my stay very short. He said he had examined the pulp dresser with much interest; that it was very ingenious, and could be furnished at a much less cost than the Ibotsen bare screen as he was then making them, but should Ibotsen adopt slit plates such as we had on our revolving pulp dresser, it could be made at less cost than ours; but he was making planers and tools for the Ibotsen that would reduce the cost of their production, and at the same time insure greater accuracy than he had heretofore obtained by grinding on lap wheels. He named the royalty he was paying Ibotsen on all he made. He showed me a list of all the Fourdrinier machines he had built, and also those he had already added the pulp dresser to, and the number that would still be obliged to have them of some kind. The one I had brought, if introduced either with or without patent, would to some extent be a dividing competitor and a cutter down of profits. He did not think, without personal attention in England, I could put it in the hands of any one to manage with any certainty of being reimbursed the outlay of securing the patents. But he believed it would be to the interest of Ibotsen to own and control it, either by patent or suppressing it. He had learned that Ibotsen would be in London the next day, and at his shops about noon. His object in seeing me was to state the facts, and to suggest that he should be empowered to confer with him. This would necessitate showing the machine, but in doing so he would guarantee that I should in no way be injured. If I consented to this he would like me to meet them on the morrow, when he hoped to be able to go to the shops.



Sections of Boiler.—See Page 1.

This being so arranged, I got up to leave, but he pressed me to stay. He was feeling better, and he felt a little friendly interchange of ideas would cheer him. Finding that I had considerable acquaintance among the artists it opened a subject that I was surprised to find him so well posted on, for I did not look for it in one whose whole life had been so intensely devoted to mechanical pursuits as his had been. After considerable talk on general subjects far away from either civil or mechanical engineering, he asked if I had any experience in turning copper and leaving it perfectly smooth from the lathe tool? Very little, I replied, but I had seen much of it done on calico printing rolls, in Baldwin & Mason's shop. Then came the direct question: Do you think you could cover a well-turned drying cylinder, say 3′ diameter by 6′ long, with 50 pound copper, that is, copper weighing 50 pounds to a sheet of 30″ by 60″, turn and finish it as perfectly as those I had seen in his erecting shop? I said I could readily understand the difficulty of turning thin copper when not cemented or soldered to the cylinder, but I did not see any difficulty in accomplishing it without the use of the lathe further than in polishing after the copper on the cylinder had been drawn through a highly polished die, and only then to give it the appearance of having been turned, for, as finished by the die they were forced through, they would be left as near perfection as possible. He asked me to explain what I meant by drawing cylinders, of the magnitude of his drying cylinder, or even supposing such a thing possible? I replied that I did not see any difficulty, that it was only a question of size and power of the machine to do the work; that at the time of the partnership of my father and Jacob Perkins in building fire engines, copper cylinders from 3″ to 8″ diameter were perfectly finished by forcing through well-turned and polished dies; that on one occasion an air vessel of 16″ diameter had been finished in the same manner.

He thought I had said drawing, and now I said forcing through dies; would I explain any difference between drawing and forcing? None other than if drawn horizontally through a die, the great weight of the cast-iron drying cylinder acting as a central mandrel would seriously affect the uniform thickness of the copper and smoothness of the work; that this would be avoided by a vertical position and forcing upwards through the die. He asked how I would proceed to do the job in that way. I replied that after bending the sheet copper to the size to fit tightly on the cast-iron cylinder and brazing its union, taking care that it had been thoroughly annealed, I would close the upper end sufficiently over the end of the cylinder to insure its entering the die and holding it fast to the inner cylinder, then place it on the platform of a Bramah hydrostatic press with length of plunger or lift greater than the length of cylinder to be covered; the columns of the press would be the guides for the platform, and by having heavy screws and nuts on them they would at the same time hold the great die. The next question was, Did I ever see or hear of anything of the kind? No other than the old toggle-joint press that was used by Jacob Perkins and my father in drawing fire engine cylinders; that the Bramah press, that was then being extensively introduced in the English paper mills, was the natural sequence of the crude toggle-joint with all its wedges and keys. Suggesting the use of the hydrostatic press was only an application and no great stretch of imagination. Probably not, said Mr. Donkin, having had the advantage of seeing a copper cylinder of 16″ diameter successfully finished in that way. But without this to conceive of and put into practice on so large a scale required no little thought and much boldness in the necessary outlay—machinery that, if not successful, would prove a serious loss.

I remarked that since seeing the machine in his erecting shop I had learned some facts in relation to drying on iron cylinders without the copper covering. The finest qualities of copper plate paper, used by J. Murrey, the Ackermanns and Windsor & Newton, for the finest works of the engraver, were from John Dickinson's mills, and entirely free from iron mould or specks. But what assurance, asked Mr. Donkin, have you that the paper was not dried on copper cylinders? I replied the assurance of Mr. Dickinson himself; that I had dined and spent last evening with him, and the subject of drying paper by steam-heated cylinders had been fully discussed; that for gradual, steadily increasing heat with uniformity Mr. Dickinson gave a decided preference to iron over copper; that he had sketched his arrangement giving the number and size of the drying cylinders that he had found the most effective and reliable for his heavy plate paper; that he had promised me a set of tracings of his most approved dryer, with no other restriction than that I should not show them in England. He had said that he made no secret of his preference for iron dryers, notwithstanding the increased surface required over the ordinary copper ones, but I considered what he had said, as to the arrangement of his drying cylinders, and manner of working them, as confidential, being included in his request in regard to not showing his promised tracings in England.

Mr. Donkin was much surprised at Mr. Dickinson having been so free with me; he thought it most extraordinary, inasmuch as it was well known that he had more reliance on secretly working than on patents to protect him in his inventions, and of all paper makers in England he was the most rigid in enforcing the rule of non-admittance to his mills without a special permit from himself; that all of his machinery was made at his own shops under the same rigid secresy. I replied that he had offered me a letter to the manager of one of his mills, but would prefer accompanying me if I remained in London over the present week; that I should most certainly avail myself of this.

The reference I made to Mr. Dickinson's preference for cast-iron dryers without the copper facing I felt was unfortunate, for it seemed to cast a shade over Mr. Donkin, and he sat as if in deep thought; he suddenly roused himself, and said, if it was not intrusive or impertinent, he would like to know how I had met with and become acquainted with Mr. Dickinson. Not at all, I replied; Mr. Charles Leslie, the artist, had taken me to Ackermann's great artists' emporium, and introduced me to Mr. Ackermann as a son of one of his old Philadelphia friends and grandson of Chas. W. Peale, the artist, who, up to the time of his death, had been a correspondent of their house. Many fine specimens of art were shown us. The subject of the satin-faced plate paper, then being made by Dickinson, of which the Ackermanns were large consumers, was freely discussed in a manner very interesting to me, so much so that I expressed a wish to meet Mr. Dickinson. Both Mr. Leslie and Ackermann proposed going to his city office at his great paper warehouse.

In this way my introduction was most favorable. We were taken through the warehouse among immense stacks of paper, and into a room where there was at work one of Mr. Dickinson's recent inventions—rotary cutters for cards, principally for playing cards, with greater accuracy and leaving a more perfectly rounded edge than was made by the ordinary shear cutting.

When I was introduced, it was as an American engaged on paper machinery, and being a young man, as a matter of course, Mr. Dickinson's principal attention was to the great artist, and to the large consumer of his paper; and I walked with them, listening and taking but little part in the conversation, until Mr. D. asked me if I had ever met a Mr. Greatrake in Amer-

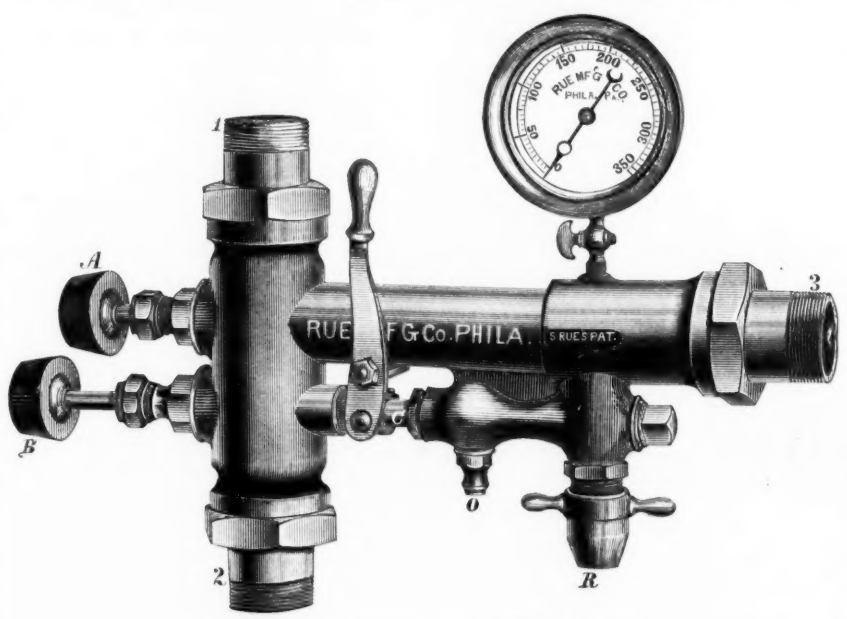
ica, who many years before had been taken from him by Mr. Thos. Gilpin offering a higher salary than he could at that time afford to pay. On my replying in the affirmative, and that I was well acquainted with Gilpin, and thoroughly posted as to his cylinder paper machine, he then spoke of Greatrake as having been one of his most reliable and trusted employes; that it was a severe blow his leaving at the time he did, knowing that he had taken with him to introduce in the States his inventions, that they had together worked on for years, through great difficulties. He was very bitter on Gilpin for, as he called it, buying Greatrake to get his inventions. Before we left, he asked me if I had ever met any of Mr. Greatrake's family. He referred particularly to a daughter, Eliza, who many years ago had written to his wife, announcing her marriage, since which time they had lost all trace of her. I told him her case was a sad one; her husband was my mother's brother; that since the birth of her only child she had become a hopelessly confirmed invalid. Mr. Dickinson would like his wife to meet me, and learn something of her old friend, and regretted that his family were at his Brighton house. He was going on Saturday, to spend Sunday, and urged me to accompany him; but I had other engagements. On the Monday evening following I had a note from Mr. Dickinson, inviting me to dine with him the next day, saying his wife and son had come up to London with him to stay over that day.

This outline of the way my acquaintance with Mr. Dickinson had been brought about, Mr. Donkin said most satisfactorily accounted for the freedom with which he had spoken of his machinery to me, knowing what I did of the machine Greatrake had put in operation for Gilpin. There was nothing further to conceal. He then added that Greatrake leaving when he did was a great loss to Dickinson; that he had been his right-hand man in carrying his plans into successful operation. It was true that the running two forming cylinders at the same time in different grades of paper pulp, making the fine, veneered plate paper, had been perfected long after Mr. Greatrake had left, but that being secured by patent, and a general description having been published in Newton's journal, accounted for his freedom in speaking of it.

After this, Mr. Donkin dropped back into a free and familiar discussion of the state of mechanics and their advance in England. Great and successful inventor as he was, and one who had done so much in perfecting whatever passed through his hands, and who was certainly the most progressive machinist I had met in England, yet he seemed to labor under false impressions, and not clearly to understand the condition of things that led to such rapid advances in mechanical pursuits in the United States. He made notes of the wages we paid for skilled labor and such cost of crude materials as I could give him. Then he came back to the squirrel cage cylinder, and said he could not see how we could afford them at the price I had named. As I had myself made many of them, I went fully into detail, and seemed to satisfy him that the higher wages naturally led to mechanical contrivances, and that, in the case of the cylinders, they were of the simplest possible kind, and yet as labor savers that portion of the cost was reduced below the cheaper labor in England; that, in the crude materials, the iron and bars, the saving was made in proportioning the parts to the work they had to perform, the American cylinder not weighing over two-thirds that of the English.

Laying on his table I noticed what appeared to be samples of pliers, nippers, and a few such like tools. I picked up a pair of pliers, and remarked that it looked like an American tool—not so clumsy as those I had seen in use in shops I had visited. "Strange," said he; "they are samples from Stubb s, of Sheffield, and they are sent as the American pattern," and, he supposed, were being introduced under that as a distinctive name. He seemed greatly surprised when I told him they were fairly entitled to be called the American pattern; that the brothers B. & E. Clark, of Philadelphia, watchmakers, in addition to their watch and clock repairing business, kept a supply store of watch and clock makers' materials, including tools; and in my earliest recollection they were the only parties in Philadelphia that kept on sale Stubbs steel, files, etc. They were fine workmen and ingenious men, who either altered English tools or made those they used of such form and proportions as they found best adapted for the general work they had to do. Samples of these were sent to Sheffield to be duplicated, and for a considerable time they were the only parties who kept them for sale; but they had spread until they became universally adopted. That in Birmingham, I had noticed the same thing taking place in general hardware—the class being made for the American market materially differing from that for home consumption, being generally lighter and more elegant in form. That I had learned that in every case the change had been made to conform to patterns or drawings sent from the United States. He spoke of the feverish state of excitement among his best skilled labor, owing to the glowing accounts they received from brother workmen who had emigrated, and he asked me as to their real condition. Men he said who, on the English plan of division of labor, were only perfect on a single branch, he did not believe it possible could find constant employment on that—in a comparatively new country. I told him that he must bear in mind that America's start in mechanical art was at the point England had reached and without her prejudices. That the men who at home would resist the introduction of labor-saving machinery were glad to accept such as they found in America, as by it they were enabled to turn their hands to general work as it offered. I reminded him of the English prejudices that years before had led to the riots that destroyed the nail-cutting machines that Samuel R. Wood, of Philadelphia, was endeavoring to introduce in England. Wood was a member of the Society of Friends and non-combative, and he left England in disgust.

I said it would be impossible to estimate or realize what the rejection of the cut nail had cost England. Its invention in America filled a vacuum and was almost a necessity, not only as to first cost of the nails but as great labor-savers in carpenters' work; that I had noticed that in England every carpenter had in hand either brace and bit, gimlet or brad-awl, according to the work he was doing, for without them the square uniformly tapered hand-made wrought nail was the best possible form that could be devised to split the wood it was driven into, without first boring a hole to receive it; that its tapered form, if not driven through and clinched, would lose its hold on the least starting back—still they continued in common use; that on watching the joiners at work, I believed I was safe in estimating that for every English nail driven, the user of the American cut nail would drive four or five. That in patternmaking shops I had seen the wrought clout in use by having its head flattened edgeways by a stroke of a hammer, and then it made a ragged hole to be filled with wax or putty. Mr. Donkin smiled as he said, "I have long been using in my pattern shop the American cut brads;" then he must understand the point; but I would give another instance of the fixed ways and prejudice of the old country that kept back improvements. Mr. E. R. Sheer, a pianoforte maker of Philadelphia, in fitting work where wood screws had to be withdrawn and again driven in the same holes had found it difficult to make the common square end English wood screw enter and follow the thread cut by the first insertion; he had mounted a clamp chuck on a foot lathe that would grasp the shank of the screw, then with file and chasing tool he tapered the end of the screw like that of a gimlet. He had given me several of these as samples, with the request that when in Birmingham I would induce some good screw maker to fill a considerable order of gimlet-pointed screws. I had gone to the makers with a prominent shipper of hardware through whom they received most of their American orders, and we had failed to induce any one of them to fill the order; they and their predecessors had always made wood screws as they were then doing, and they would have nothing to do with such new-fangled notions. Mr. Donkin did not expect Mr. Ibotsen before noon, and said if I could come to his shops one or two hours in advance he thought he could show me a shop that had abandoned some old fixed ways and made fair advances, and added—if it has not kept up with America.



Device for Washing and Testing Boilers.

Device for Washing and Testing Boilers.

The apparatus which we illustrate herewith is designed for both washing out and applying hydrostatic pressure to boilers, using warm instead of cold water. It is an improvement on the device heretofore made by the company for that purpose. By its use boilers are not only much more effectually cleaned than by the use of cold water, but in applying pressure for testing it is very generally acknowledged that warm water conduces to safety; it may also be noted that in filling the boiler with hot water steam may be raised in much less time than in firing from cold water.

In using this device for applying pressure, from three to five times the pressure of the steam required to operate may be maintained on the boiler under test.

All that is necessary is to place the apparatus where cold water will flow to it, the hot water passing to the boiler with great force.

The manufacturers are the Rue Manufacturing Company, Philadelphia, Pa.

Locomotive Shop Notes.

At the Cooke locomotive and machine shops, business looks to be very brisk. The president, John S. Cooke, informed us that although they had quite a number of orders on hand, they had to be taken at a very low figure; leaving a very small margin of profit, if any. Indeed, if it had not been for the number of trained hands which they employ, and whom they are anxious to prevent from seeking employment elsewhere, by giving them steady employment, it is very doubtful if they could afford to build these engines for the price agreed upon. Their system of building engines is excellent. They employ an excellent corps of draftsmen.

At the Rogers locomotive and machine works business is tairly good. Here also an excellent system of building locomotives has been established. Under the energetic and careful management in late years, boller making has been brought to such a state of perfection, that now a 50 or 52 inch boiler for an ordinary eight-wheeled locomotive is built in fourteen working days. In the beginning of this month Mr. Reuben Wells, late Master Mechanic on the Louisville and Nashville road, who has a high reputation as a mechanic and has been a friend of the Rogers locomotive and machine works of many years standing, has connected himself with these works.

At the Grant locomotive works locomotive building is also progressing. They are now engaged in building ten eight-wheel passenger locomotives for the Union Pacific Railroad. Besides these they have orders on their books for a number of locomotives for one or two other roads.

Hitherto we in this country have had, so to speak, a monopoly in engines that, in the mind, were to do work without dissipating heat. More recently, however, we see that Mr. Hargraves, of England, has devised an engine for running at an expense of 2 cents per hour for 20 horsepower. Mr. Hargraves, to use an Americanism, "takes the cake." He ought to start a stock company in New York, without delay.

The Industrialist, issued from the State Agricultural College, Manhattan, Kan., carries at the head of its editorial page the notice that it is "Edited by the President and Faculty." We suggest that they let the students edit it a while for a change. Among our exchanges are some bright, lively periodicals edited by students of certain colleges.

General Berdan is authority for the statement that it takes a charge of 1,900 pounds of dynamite, in a torpedo, to penetrate 24 inches of armor plate. The general has invented a torpedo that is to find its way underneath the attacked vessel, when it is said that 200 pounds of gun cotton will do all the work required.

"The most modern siege guns cost $97,000, and it will cost $900 to fire one of them only once." If we were to be presented with a modern siege gun for a birthday present, or a token of respect, or something of that kind, we should never fire it—not even on the Fourth of July. It would bankrupt us.—*Norristown Herald.*

Industries, an English journal, calls attention to the fact that the balance sheet of limited companies is very generally based upon fictitious valuations, and that therefore there is but little confidence to be placed upon the return of profits, some of which is applicable in this country.

The *Washington Republic* says Thomas Jefferson was the first maker of cut nails in this country. His nails were sold by agents at from 13 to 17 cents per pound.

The Brotherhood of Locomotive Engineers will hold its next annual meeting at Chicago, in October.

LETTERS FROM PRACTICAL MEN.

Vacuum Motors.

Editor American Machinist:

Yes, an engine can be run by a vacuum. Let exhaust pipe of engine as above be connected to a vacuum or partial vacuum, say the condenser of another engine, or a suction produced by an induced current as in the injector, and the steam chest be connected with the external atmosphere, or removed entirely, and the engine will run without any steam at all. If not, why not?

Mr. Bourne would, no doubt, call this an "unbalanced plenum," but that is a mere juggling with words. Most people will call it a vacuum on one side of the piston and atmospheric pressure on the other.

Passaic, N. J. Wm. Kent.

[Mr. Kent evidently refers to a statement in our issue of May 14, to the effect that a vacuum would not run an engine. The assertion that an engine can be run by vacuum does not change the well-known fact that vacuum neither moves the piston of an engine nor assists in moving it.

Therefore, we repeat our statement made in the issue of May 14th, "that an engine cannot be run by vacuum." But right here is where Mr. Kent has misunderstood us; and right here also we believe that Mr. Kent is wrong in saying that "an engine can be run by a vacuum." Relieving some of the resistance against which the piston must be moved by the application of force, that is creating a vacuum on one side of the piston, without having any pressure on the other side of the piston, no more runs an engine than throwing off two-thirds of the machinery in the mill; and, therefore, we say that an engine cannot be run by vacuum. But as soon as air is admitted on the other side of the piston, as Mr. Kent's sketch shows, then of course the engine will run, and this we have never denied.

The sketch to which reference is made is of an ordinary engine cylinder and slide valve with the steam chest removed and the exhaust piped "to vacuum." If Mr. Kent will again read the article he criticises he will find a reasonably plain statement of the fact that an engine may be run by "air that is admitted or finds its way behind the piston in sufficient quantity to move it." We assume that this is sufficient answer to his query. We are not prepared to admit that a plain statement of fact is "juggling with words."]

Vacuum Motors.

Editor American Machinist:

I wrote you a letter last week concerning vacuum motors, and asserting that I had driven engines thirty years ago by vacuum alone. Every engineer understands by this assertion that the condenser exhausted the air behind the piston, and that atmospheric pressure on the other side of the piston exerted its force to impel the piston. You deny the possibility of this in your remarks appended to my letter in your issue of May 14th, and go to John Bourne to fortify your position. Now, if you will go a little further back still, say to Newcomen, Marquis of Savery*, and Watt's days, you will find that they used steam only one way, and atmospheric pressure the other way, utilizing the same by the aid of a condenser. Perhaps you will be willing to admit that if the atmosphere will act on one stroke it will also act on both strokes if it has a chance. This it does when engines are connected to a condenser, and I do not understand where there is any opening for an argument or discussion. I have never made the assertion that an engine would work on a vacuum alone without atmospheric pressure, and any one who says I have misrepresents the facts.

Perhaps you will be kind enough to inform me how a leaky throttle can affect the low pressure piston of a compound engine? With 75 to 90 pounds pressure in the steam chest the receiver pressure ranges from 14 to 9 pounds per square inch, according to the point of cut off in the h.p. cylinder. Now tell me, if you please, how much pressure "a leaky throttle" would give in the receiver and how much steam pressure there would be on the low pressure piston?

The facts remain as stated, that the engine of the Chicago, U. S. N., ran continuously until the condenser communication was cut off by a cock specially placed for that purpose. Shutting the throttle had no effect upon the working of the engine.

Your remarks upon the vacuum motor I sent you, give a very plain contradiction to your own position, and you assume a condition of things for your own purposes which do not exist. There is no safety valve on this boiler, but a simple disk like a stove-lid, and, as I remember it, about the same size and weight. I leave you to explain how such a device as this would permit any working pressure on the boiler equal to 12 pounds M. E. P. in the cylinder.

Egbert P. Watson.

[We have published Mr. Watson's communications entire, and our readers can read for themselves exactly what he has written. We distinctly intimated (May 14 issue) that air, if admitted, might move the piston of an engine, and Mr. Crane did the same in his communication which appeared in our May 7 issue. We have not put words in Mr. Watson's mouth, and must insist that he shall not supply us with words.

If Mr. Watson means to ask us to admit that the old time atmospheric engines to which he refers would have run if air had been freely admitted to both sides of the piston instead of steam to one side, we must respectfully decline. For reasons too obvious to mention they would not have run at all under these conditions.

No one, so far as we know, denies that a modern steam engine could be converted to a double-acting air engine. But simply connecting the exhaust of a steam engine to a condenser is not sufficient to convert this engine to a double-acting air engine; we must also provide means by which air can flow into the steam chest and be admitted into the cylinder (the same as steam) to drive the piston.

We all know that there is no mysterious process by which air will find its way through solid metallic walls to establish a pressure behind the piston, but a proper opening for this purpose, as stated, must be provided for, and upon this point there is no room for "argument."

A leaky throttle valve will affect the low pressure piston of a compound engine precisely as a small quantity of steam admitted in some other way will do, and it is quite within reason to suppose there might have been leak enough to keep up motion of the Chicago's engine, an independent engine driving the air pump. Without knowing anything about the conditions it is more reasonable to suppose that the throttle leaked than that air was admitted, or leaked in sufficiently to run the engines, although the latter supposition may be true; which supposition is true is quite immaterial.

As "a leaky throttle valve" is rather indefinite, we shall not hazard an opinion as to the pressure in the receiver, but it would undoubtedly be somewhat greater than in the condenser. If the throttle was tight, and "closing it had no effect upon the working of the engine" then the motive power of the Chicago is truly remarkable.

Our remarks upon the "vacuum motor" were entirely correct, and contradict nothing we have said; the assertion that we "assume a condition of things" in regard to that motor is not true. The "simple disk" performs all the functions of a safety valve; when the pressure in the boiler exceeds the pressure of the atmosphere, by a trifle, due to the weight of the disk, the latter is lifted from its seat, and steam escapes from the boiler. Getting a mean effective pressure of 12 pounds on the piston of this engine, with 15 pounds pressure in the boiler, appears to be a very simple question of large ports, a —very nearly—full stroke valve, an efficient air pump, with plenty of condensing surface and condensing water.]

*Mr. Watson's reference seems a little misty here.

The Effects of Hardening Steel.

Editor American Machinist:

I am disposed to question the absolute correctness of your answer No. 208. It is not in accord with my experience that steel shrinks in hardening. A piece with a hole in it will usually be found smaller in the hole, but will also be larger upon the outside. The surface of the metal seems to rise. We have hardened reamers three or four times and found them a trifle larger after each successive hardening. There is quite a difference in the action of different makes of steel in this respect.

Frank H Richards.

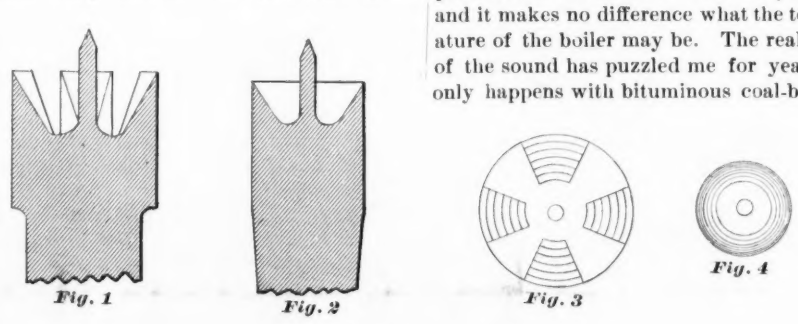
Buzzing in Locomotive Boilers.

Editor American Machinist:

The buzzing sound in a locomotive boiler, to which question 202 refers, is a sound produced when the fire is severely forced, and it makes no difference what the temperature of the boiler may be. The real cause of the sound has puzzled me for years. It only happens with bituminous coal-burning locomotives, and some kinds of coal produce it much more readily than others. If you drop the dampers and restrict the admission of air, the sound ceases. It is connected with the act of rapid combustion in some way; but just how the sound is produced is inexplicable to me. You will hear it sometimes with painful distinctness an eighth of a mile away.

I once saw a theory that it was caused by the violent combination of oxygen and hydrogen, the buzzing being an aggregation of minute explosions.

Engineer.



Centers for Wood Turning.

Centers for Wood Turning.

Editor American Machinist:

Your issue of Dec. 11, 1886, contains an article by Mr. F. W. Barrows, on "Machine Tools for Patternmakers," in which are shown and described several kinds of centers for wood turning. I need not discuss any of them, as Mr. Barrows fully explains the good and bad points of all of them.

In the closing paragraph Mr. Barrows says a center might be devised for live spindle that would safely hold small light work, and would be a desirable tool; and as laziness and necessity, the father and mother of invention, led me to make such a tool some five years ago, which I have used more or less ever since, I will describe it for the benefit of the trade, first stating that I am a machinist, but make some patterns because I have to.

Fig. 1 is a longitudinal section of the live center, and Fig. 2 of the dead center, while Figs. 3 and 4 are end views of the same, respectively.

It will be seen that the dead center is nearly the same as Mr. Barrows' Fig. 76, or the common point and ring center, which is very old, while the live center is of the same shape, although larger, but with four notches cut in the ring, which produces, or rather leaves, four teeth for holding and driving the work.

There is, however, a radical difference between these centers and Mr. Barrows' Fig. 76, in that they are straight on the outside, instead of tapering, which latter form has a tendency to force the work apart, while mine do not.

The dimensions of this pair of centers, which are the only ones I ever made, are as follows: Live center, $\frac{3}{4}''$ diameter; dead center, $\frac{1}{2}''$ diameter; diameter of point, nearly $\frac{3}{32}''$, and the points project beyond the edge of the ring $\frac{3}{16}''$.

The angle of the taper inside of the ring with the outside of the center, or with its axis, is 30° in both centers.

The teeth on the live center are $\frac{1}{4}''$ long, and the circular groove in the dead center is about $\frac{3}{16}''$ deep.

The teeth on the live center are produced by cutting four notches, the side lines of which should be radial, in order to leave the teeth strong and not cut away the bevel inside the teeth too much, as this is what draws and holds the two halves of the work together. The teeth and spaces should be as near as possible of the same size, each tooth and each notch being one-eighth of the circle. These spaces could be cut with a milling cutter of the right shape, letting the cutter into the body of the center in such a way as to clear the point of the center.

These centers can be made of any size, and large sizes for live centers might be made of cast-iron, and to screw on the spindle, with a steel ring on the outside, in which to cut the teeth, and with the center point inserted, as Mr. Barrows suggests.

The two centers may be of the same diameter for large work; but a small dead center is better for small work, as it does not tend to twist the work so much as a larger one, and on small work, having small core prints, this is important.

I consider $\frac{3}{4}''$ for the live, and $\frac{1}{2}''$ for the dead center, as the smallest sizes that are needed; yet, with a little care, I have turned a split pattern, 12″ long and 3″ diameter, and small patterns, from 2″ to 3″ long, with $\frac{3}{16}''$ core prints on each end.

These centers are as good for solid work as any, and patterns can be turned in four pieces, equally as well as in two pieces; and a half round piece can be turned as well as a full round.

The live center drives very strong—I think as strong as any other, and the work never gets loose sideways.

I have turned patterns for cored work of irregular shape in halves, and then turned the core pattern in halves, and obtained the proper shape and size by trying one-half of the core pattern on one-half of the pattern, as the work can be taken out of the lathe and put back as often as necessary, the same as if solid. I also sometimes turn the round parts of solid patterns in halves, as it is often easier to make a pattern in that way.

When a job is long and springy, of course it will need one or more screws in it, to prevent the centrifugal force from throwing it apart in the middle; but if these centers are of a size in proportion to the work, dogs and center plates on the ends of the work can be entirely dispensed with.

In using these centers, after getting out the two pieces for a split pattern, put a hand-clamp on each end, if it is long enough; if not, then put on one, and make an awl hole in each end of the pattern, as near as possible in the joint. Then put the job in the lathe, and turn up the tail spindle, until both centers are far enough into the wood, and then take off the clamps, oil the dead center, and go ahead. These centers should be tempered a low blue, about like a screw-driver.

I do not claim that a half pattern can be turned with these centers, which shall be found, after turning, to have the joint exactly in the center every time; but it will come very near, probably as near as any, for none of them are perfect.

I will send you by mail some small jobs turned with the centers, and leave the ends on, so that you can see the marks of the centers.

H. K. PORTER.

Boston, Mass.

Boiler Explosion.

Editor American Machinist:

In your issue of May 14th, under the head of "A Disastrous Explosion," you make several misstatements as to the facts, which I know from a careful examination are not as stated.

First—"That they found that the iron had been rusted away until it was only $\frac{1}{16}$ of an inch thick in some places, *and nowhere more than* $\frac{1}{8}$ *of an inch thick.*"

Second—"That this boiler had been inspected recently, and 80 pounds of steam were permitted, *while but* 40 *pounds were on at the time of the explosion.*"

Third—"*It was thought necessary to replace the last boiler by a new one*, which is now finished, and has been standing for some time in the street, only a block or so away from the scene of the accident."

The italics are my own.

Now as to the facts.

First—The iron does at a few places show about $\frac{1}{16}$" thick where it broke through a part of the iron which was laminated, but otherwise the plates are full $\frac{5}{16}$" thick.

Second—The boiler was inspected and insured by the American Boiler Insurance Company a short time prior to the explosion, and pronounced good for a pressure of 60 pounds per square inch. This boiler was fitted with a new "differential valve" some two months back, and also had a safety valve attached, that would blow off at 40 pounds per square inch; this valve after the explosion is in good order.

Third—Last fall there were three small rag boilers, and it being deemed more economical to have one large one in place of two of these, one was ordered of the Cooke Locomotive Works, but it was not completed according to the specifications. This new boiler was not to take the place of the one just exploded—as they expected to still use that for certain work.

W. BARNET LEVAN.

May 7, 1887.

[We obtained our information from the most reliable sources that could be found, and endeavored to present the facts in their true light and impartially; and indeed this letter shows that on the whole we have presented the main facts correctly. We have stated that the iron of these boilers had been rusted away until it was only $\frac{1}{16}$ of an inch thick in some places, and this the letter does not deny; and further states "a few places show about $\frac{1}{16}$" thick where it broke through a part of iron which was laminated," hence, whether the iron had been $\frac{1}{8}$ of an inch or full $\frac{5}{16}$ of an thick at other places, does not alter the fact that the boiler was unfit for use. As to the inspection of the boiler we must say that since our article has appeared, a coroner's jury has investigated the cause of the explosion, and from the sworn statements brought out during this investigation, we can only come to one conclusion, and that is, the inspection of this boiler was a farce, or there was negligence elsewhere; and we believe others will come to the same conclusion, if it was true that a boiler 6 feet in diameter, running day and night for about 25 years (some say 30, others 35 years) was inspected internally, but not externally, the asbestos covering not being removed. We refer only to the last so-called inspection. And again, the intention to continue the use of the old boiler (had it not exploded) as Mr. LeVan says, instead of replacing it by a new one, plainly proves that the company, or whoever had charge of the works and authority to keep the boilers in good condition, either were or was profoundly ignorant or guilty of gross negligence. In fact, the coroner's jury pronounced it in their verdict "gross negligence." And lastly, as regards the safety valve to which Mr. LeVan refers, we have only to say, that the third person who lost his life through this explosion, made, a few days before he died, a sworn statement that this safety valve was out of order, and he had drawn the attention of the superintendent to this fact more than once, but it was not repaired.]

The Fitchburg Water Motor.

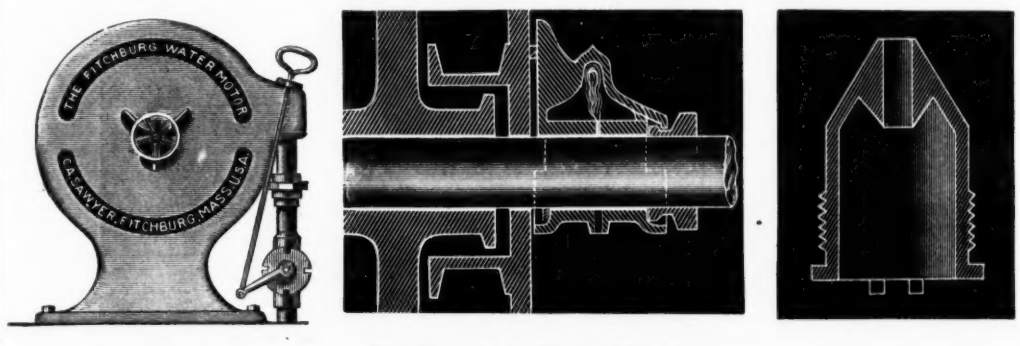
This motor is of the jet type, and while not so economical in the use of water as the piston motor when both are new, it is claimed that after a few years' use the jet motor will have the advantage both as to economy and in relation to repairs.

The buckets, jets, and all parts liable to injury from rust are made of hard brass. In all joints that come in contact with water, one of the parts is made of brass so that they cannot rust together.

The shape of jet, as shown in cut, is the one selected as the best form to throw a solid stream the furthest without breaking, the stream being cut, as it were, from the center of the water in pipe.

The shafts are of steel, standard size, so that pulleys can be changed at will.

The motor wheel is fastened to shaft by a brass screw, with a brass bushing in the hub, as shown by white line in cut. A flange on the end of wheel hub in connection with a stationary flange on the inside of the case prevents the water from getting outside of the case. The shaft does not touch the case in passing through the side, the hole for it being slightly enlarged.



THE FITCHBURG WATER MOTOR.

Bolted to the side of case is a housing or support for the journal box. The boxes are lined with babbitt metal, and are hung in a ball and socket joint, so that they are free to adjust themselves without cramp or bind on the shaft in bolting the housing to wheel case, or in bolting case together. In the underside of box is a hole filled with wicking leading to a reservoir in housing under the box; this wick conveys the oil from the reservoir to the shaft in ample quantity for lubrication, the surplus oil being returned to the oil reservoir by peculiar-shaped collars on shaft at either end of box, there to be used over again. This motor has a box on either side of case, only one being shown in cut. Jets, shafts, holes in pulleys, and all small parts are made on the interchangeable plan.

C. A. Sawyer & Co., Fitchburg, Mass., are the manufacturers.

The United States Patent Laws.

BY JOHN MCCLARY PERKINS.

One hundred years ago, when the Constitution of the United States was formed, among its provisions was a grant authorizing Congress to pass laws "to promote the progress of science and the useful arts." In pursuance of that authority the Act of 1793 provided for the grant of patent monopolies by the Government of the United States. On the proper application of inventors for patents for improvements in "science and the useful arts"—letters patent were granted to these inventors according to the terms of the Act of 1793—the subject matter of patents being substantially the same at the present time as it was under the original patent Act of 1793.

But in 1836 a radical change was made in the manner of granting patents. The Commissioner of Patents was authorized by the Act of 1836 to employ examiners or clerks to assist him in making a preliminary examination into the merits of the claimed invention before a patent was granted for the same. That little speck then in the sky has repeatedly been enlarged, so that now the contests in the Patent Office are beginning to rival in enormous cost and endless machinery the infringement suits in Federal Courts. No poor man can think of maintaining his patent monopoly in the Federal Courts—the expense is so immense—and the decisions of the court are so uncertain on the same state of facts. It seems to be not so much the merits of the patent that preponderates the court decision, as does the "eminent" reputation and the high price of the lawyer that is hired to manage the patentee's case before the court. However abhorrent to a healthy mind this statement may be, the significant and well-known fact remains. Within a stone's throw of the sheet on which I write is a rich corporation that is "engineering" a valuable patent through the Patent Office now, and it is estimated by the interested parties that it will cost not less than eight thousand dollars, all told, in order to secure that patent grant from the Patent Office. Of course it goes without saying that no patent honestly obtained could cost so much money. The Government fees on a patent are $35. And the attorney's fees could not much exceed that sum—making the whole cost about $70—if there was no "crookedness" in the Patent Office work, and also provided the patent laws were not loaded down with unnecessary and cumbersome machinery for Patent Office proceedings. And after the patent is granted by the Patent Office, there is nothing settled. Precisely the same ground must be all gone over again in the courts, and the Patent Office proceedings will have no weight nor authority before the courts. The public opinion of the United States is beginning to demand, I might almost say command, a radical change in the administration of the patent law or else its repeal altogether. It certainly is not accomplishing the work for which it was created. All this cumbersome, expensive, and very injurious Patent Office machinery should be abolished, and that right speedily. Patents should be granted as they were in the United States before 1836, and as they are granted in England, and in all the rest of the world—upon the application of the alleged inventor alone, and without special examination on the merits by the Patent Office. And if there are contentions among alleged inventors, let them settle their differences in the courts. At the present time these contests about patents can only be settled by the courts. Then why tax the inventors with all this useless scrimmage in the Patent Office before the grant of the patent? It leads to favoritism, corruption and enormous cost, for which the contending parties must suffer. Let the inventors and manufacturers and patent owners of the country examine into this matter, and I am sure that there will be a united voice which will wipe out these unnecessary and very costly Patent Office proceedings, as soon as Congress again meets. The poor man is entirely at the mercy of the rich and grasping capitalist or corporation in the Patent Office, whenever the value of the invention invites a deadly struggle there.

And as to the fate of the poor inventor in the courts, after he secures his patent grant, it is too well known to need any very extended comment. There is no great change needed in the patent laws as they now exist, so far as the courts are concerned. But there is needed a great change in the administration of justice under the patent laws, as too many inventors, patent owners and poor men can well attest. But I will leave this matter about the fate of patents in the courts of the United States by quoting a carefully considered editorial from the pen of the scholarly editor of the Albany (N. Y.) *Law Journal.*

"We publish this week a remarkable communication about the patent system. We have for many years believed that there is a great deal of humbug in the system itself and a great deal of oppression and injustice in the administration. Our correspondent sets forth a terrible arraignment, and yet we dare say the experience of almost every patent lawyer will confirm him. It is notorious that most poor inventors are cheated out of their rights by the oppression of capitalists, and the tediousness, inequality and expensiveness of the practice in the patent courts. We have no doubt, too, that some of the Federal judges carry on things with a high hand when the mood is on them. This comes of making them independent of the people, whose servants they are. It is a wholesome thing to have a judge to know that he is liable to step down and out at a fixed time if he does not behave himself. A judicial tyrant is the worst sort. Is not here another 'living issue' for the consideration of the American Bar Association — the Patent System and the administration of the Patent Laws?"

The AMERICAN MACHINIST is not interested in "procuring patent rights," and therefore there is no temptation to misrepresent the matter to the inventor about the value and scope of patents after they are obtained; and to deceive the inventor so as to lead him to pay out money to his patent agent which is really no better in many cases than throwing the money into the sewer. There is more misinformation, in the public mind, about the use and operation of the Patent Laws of the United States than there is regarding any other single branch of the statute law. And this largely comes from the fact that the patent agents at Washington and in other large cities seem to be banded together for the purpose of only stating such matters as facts which will bring money to their pockets. Take a single recent case: A man writes to the largest patent agency in the country about his invention. He explains it by a model and drawing. Only a moderate examination by a competent patent attorney discloses the fact that it is not patentable. Did this big and boastful patent agency so inform this poor carpenter? By no means. Where is the chance to "fleece" this poor man if that was honestly done, as it should have been done? So the inventor was told that he could secure a caveat, but that it would not be advisable at present to apply for a patent; and the inventor is further told that the Government fee is $10; that the attorney's fee for the preparation of the drawings and specification will be $15—making a total cost of $25 which must be remitted to this big and rich and much advertised patent agency; that "a caveator can use the stamp, 'caveat filed,' and such stamp sometime assists in selling the article or securing trade." This totally deceives the inquiring inventor. Why not tell him the whole truth that a caveat does not give the slightest protection to the inventor, and never was designed to do so; that the stamp "caveat filed" is not known at all to the law—and was only designed to deceive and mislead the ignorant inventor by

raising a suspicion that it gave some protection—and thus to reinforce the attempt to get $25 out of the inventor; that a caveat simply and only is a promise (often broken) by the Government, on payment of $10 per year; that it will inform the caveator or inventor if, during that year, any person applies for a patent similar to his alleged invention; and that if such other application is made it will be suspended for three months in order to allow the caveator time to make his application for a patent by paying the Government $15 more, and then to ask for that anomalous and expensive proceeding called an "interference" between two applicants in order to determine which of these two contestants is the first inventor? And in this particular case, when such a result should have been reached both applicants would necessarily be informed that the alleged invention was old and not patentable. Now, this well illustrates the tomfoolery of these unnecessary and expensive Patent Office proceedings. The remedy, as before stated, is a return to the plain and simple method of granting patents as was practiced in this country before 1836—and leaving the fate of these contests to the courts—as is now always actually done in practice. This certainly would simplify the granting of patent monopolies—and would cut off the corruption, favoritism, and great expense now incurred in the Patent Office. No other country in the world has so duplicated the trials, trouble and expense to inventors as has the United States. Could the American Machinist do a greater favor to its readers and to the mechanics and inventors of the country than to expose these patent agents' tricks to dupe the inventor—similar to the caveat trick above described?

Moulding Car Wheels.

By Robert E. Masters.

The chilling properties contained in car wheel pig irons cause the majority of mixtures to run hard at sharp corners, especially when they come in contact with a hard surface. From this cause the present style of coring out the axle hole in car wheels causes considerable expense and delay in the machine shop, much of which can be avoided.

The drawings show the wheels in section as they are put on the mill to be bored out. The top of the wheel in the cut is the bottom of the wheel in the mould. Fig. 1 is cast with the ordinary straight core *A*, and there is a tendency in most irons to run hard, and in many it will chill in a triangular shape from $\frac{1}{8}''$ to $\frac{1}{4}''$ back from the core, and about $\frac{1}{4}''$ deep around the sharp corners, as seen at the solid black marks *B B*.

Sometimes wheels from the best known firms, while they are very soft in the body, are so hard at this point that if they are not chipped out all around, the sharp chilled corner will wear a deep groove into the steel cutter, and, if pressure enough is applied, will break it. Often half a dozen cutters which cost on an average one dollar each, are ruined from this cause in a day.

C is a core made in a core box, having a fillet at each end, the result being seen in a bell-mouth opening at each end of the axle hole *D D*, Fig. 2. To make it plainer, we will say a wheel is to be bored to the Master Car Builders' standard, $4\frac{5}{8}''$. The body of the core is $4\frac{1}{4}''$, and $\frac{1}{2}''$ from each end it tapers out to $4\frac{3}{4}''$. This does away with the chipping, and lets the roughing cutter drop past the top edge and leaves $\frac{1}{8}''$ for the finishing cutter to give a smooth bearing all through. Those who have bored wheels out cored in this manner say it saves the cutter, and they can do 15 per cent. more work.

Wheels that are used to replace cracked or broken wheels and for general repairs in railroad shops have to be bored to suit all size axles, and many of them fit up to a shoulder on the axle. In a case of this kind the bell mouth on the inside of the hub will not make a good square fit to the shoulder. If the wheel is poured at the bottom *E* through the center of the core it is not so liable to have a hard or chilled edge as when poured from the top of the hub *F*. With this plan of pouring wheels the core can be left straight at *G* and bell mouth at *H*. This lets the cutter through at *H* when boring the wheels without forcing pieces off the bottom or outside of the hub, and when pressed on the axle does not show a ragged broken joint. In some foundries where wheels or other castings are poured at the bottom through the center of a dry sand core, pains are taken to vent the core all around. For instance, a center core $4\frac{1}{2}''$ diameter with a gate $1\frac{1}{2}''$ diameter through it. This leaves $1\frac{1}{2}''$ sand all around the gate. To vent this takes time and is all useless labor, as just as satisfactory results will be obtained without venting a core of this kind. To prevent the core from bursting at the bottom from the strain when pouring the mould, a piece of wrought iron pipe $2\frac{1}{2}''$ long and large enough in diameter to admit of an equal thickness of sand between the gate and pipe, and pipe and core box, is rammed up in the lower end of the core.

Mr. William Hassman, Master Mechanic of the Richmond and Alleghany Railroad, when fitting up engine No. 13 in a hurry two years ago, used as a makeshift an old style crosshead with phosphor bronze gibs, and to try the value of cast-iron guides (which are being used now on a number of

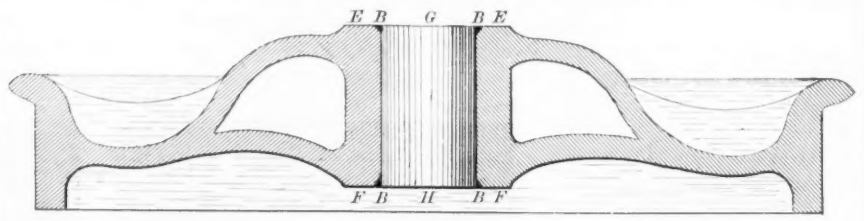


Fig. 1

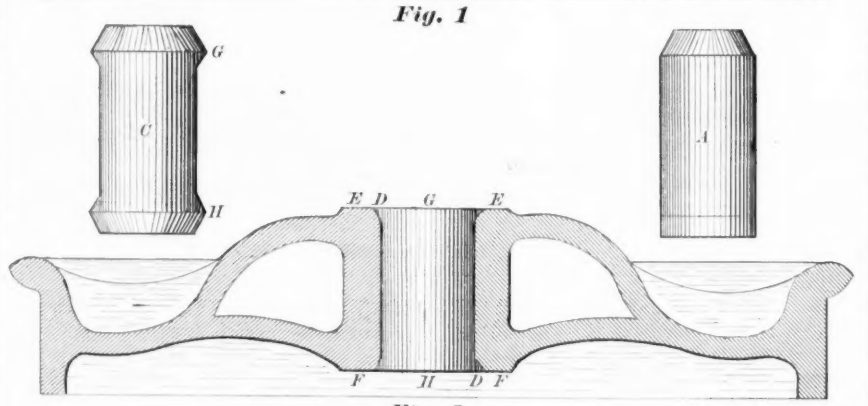


Fig. 2

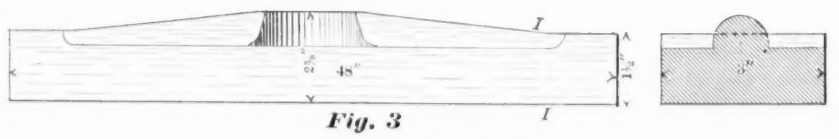


Fig. 3

Moulding Car Wheels.

roads) compared to those of steel he put in the bottom guides of steel and cast-iron top guides from a pattern shown with cross section at *I I*, Fig. 3. After the engine had made 54,779 miles, the cast-iron guides showed no more wear than the steel, but the gibs which were originally $\frac{1}{2}''$ thick showed a marked difference; the top gib on the cast-iron guide was $\frac{1}{16}''$, and the bottom gib on the steel guide was $\frac{5}{16}''$ thick, showing $\frac{5}{32}''$ more wear on the bottom gib. One would naturally conclude that there would be more wear on the bottom gib from the weight of the crosshead, but those who have had experience in this particular line seem to agree that with a locomotive on the road there is 20 per cent. more wear on the top gib, and when this is taken into consideration cast-iron seems the most preferable; the reason for this must be, the cast-iron being more porous holds little particles of oil and gives a more perfect lubrication than can be obtained on the hard smooth surface of a steel guide.

When the union meeting of the Brotherhood of Locomotive Engineers was held in Richmond, the chairman, A. J. Schevers, of the American Brake Company, told the writer the most satisfactory gib he had ever used was of block tin. We visited the Richmond and Danville railroad shops at Manchester, Va., and Master Mechanic Thomas Gentry said that tin crossheads were used to a great extent on their road, and he liked them better than any other, and that they were using a number of cast-iron guides; they use a wing crosshead and treat the wearing surfaces to an acid bath. It is then tinned. This gives the block tin something to hold to and $\frac{1}{8}''$ is sweated or cast on, and is planed down to $\frac{1}{16}''$. Mr. Gentry says the secret of success with tinned crossheads or gibs is getting a light coat on and they give twelve months continuous use without retinning.

A well known M. M. stated that in experimenting with plain cast-iron wing crossheads made from good charcoal iron he had obtained equal, if not better service than from cast-iron crossheads with ribs or plugs of babbitt metal in the wearing surface.

Our well-known contributor, Fred J. Miller, of Lagonda, Ohio, has recently received a patent on a transit instrument. The object of the invention is thus set forth:

The objects of the invention are, first, to provide a single instrument possessing all the advantages and capable of performing all the functions both of an ordinary transit instrument and an ordinary engineer's Y-level; second, to provide a transit instrument in which certain adjustments, which, in the ordinary transit, depend on the accuracy of the manufacture thereof, may be readily tested, and, if in error, corrected.

Regarding his invention Mr. Miller discourseth facetiously:

"As you will perceive, I have disregarded Prof. Sweet's advice given in the American Machinist several years ago, and have sought and obtained what he calls the 'passport to poverty, a patent.'

"The new instrument has many advantages not mentioned in the specifications, and I have hoped that it may prove a popular instrument, whether it ever pays me anything for my trouble or not.

"The first man who walks into your office and insists upon buying it, tell him he can do so cheap."

Modern Locomotive Construction.

By J. G. A. Meyer.

THIRTY-NINTH PAPER.

TO LAY OFF THE NOTCHES IN THE REVERSE ARCS.

In Fig. 204 we have represented the same mechanism as that shown in Fig. 201, but for the sake of clearness some of the details have been left out.

In Fig. 204, the line *k* on the rear end of the slides represents the extreme end of the travel of the crosshead end *j*, and the line *o* on the front end of the slides represents the extreme end of the travel of the crosshead *n*. It is now to be shown how the notches on the reverse arc *G* can be located, so that when the reverse lever latch *L* is placed in one of these notches steam will be cut off when the crosshead is in some particular given position between the line *k* and *o* marked on the slides.

For this purpose we must attach the connecting rod to the crank-pin and crosshead, so that when the wheel is in motion the crosshead will also be in motion.

In the thirty-fourth paper we have seen that there are two ways of arranging the notches in the reverse arcs *G*, namely:

1st. The notches may be cut as close together as the strength of material will allow.

2d. The notches may be cut so as to hold the reverse lever in positions which will cause the steam to be cut off in the cylinder at some full number of inches in the stroke. We will first consider how to locate the notches in the reverse arcs when steam is to be cut off at some number of full inches in the stroke.

Assume that the stroke, in Fig. 204, is 24 inches, and that steam is to be cut off when the piston has traveled 6, 8, 10, 12, 15 inches from the beginning of the stroke, it is required to find the positions of the notches in the reverse arcs *G*, and also, as is always customary, the center notch which will hold the valve motion in mid-gear.

In the thirty-eighth paper we have shown how to locate the notches for full gear forward, and also for full gear backward; it now remains to be shown how to locate the intermediate notches. First, let us find the location of the center notch, or in other words, the notch which will hold the valve motion in mid-gear. To do this move the reverse lever *H* towards the middle of the reverse arcs *G*, and in the meantime turn the driving wheel in the direction of arrow 1, that is, in the direction of the forward motion of the wheel; also watch the movement of the slide valve. When finally the reverse lever *H* arrives in such a position in the central portion of the arcs, which will give the shortest travel to the slide valve, the reverse lever is then in the desired position, and will hold the whole valve motion in mid gear, and the latch of the reverse lever will indicate the position of the center notch; therefore on the arcs *G* scribe off the end of the latch *L*, and to these marks the center notch must be cut. To locate the other notches lay off on the slide a number of fine and distinct lines, as represented in the figure by those lines marked 6, 8, etc., on the slides; in scribing these lines on the slides care should be taken not to disfigure the slides. The first line marked 6 in our figure must be 6 inches from the line *k*, the second line marked 8 must be 8 inches from the line *k*, and the third, 10 inches from *k*; in fact, since these lines show how far the piston has moved away from the beginning of the stroke, and the line *k* on the slide represents the beginning of the stroke, the distance between each of these lines and the line *k* must be equal to the given points of cut-off, namely 6, 8, 10, 12 and 15 inches. Now turn the driving wheel in the direction of the arrow 1, causing the crosshead to move away from *k*, as soon as the edge *j* of the crosshead touches the line marked 6 on the slide, stop the motion of the wheel, and then slowly move the reverse lever *H* towards the forward end of the reverse arc *G* until the slide valve has just closed the rear steam port, then on the arcs mark off the end of the latch, and thus locate the notch which will hold the valve motion in a position that will cut off steam at 6 inches from the beginning of the stroke. Again turn the driving wheel in the direction of the arrow 1, and when the edge *j* of the crosshead touches the line marked 8 on the slide, stop the motion of the wheel, and then move the reverse lever towards the forward end of the arc until the slide valve has just closed the rear steam port; then again on the re-

verse arcs mark off the end of the latch L and thus locate the 8 inch notch. In a similar manner the locations of all the other notches in the forward gear are obtained. In this example we have assumed that the valve motion has been correctly designed in the drawing room, and also correctly put up in the erecting shop, and consequently we do expect that, when the driving wheel moves in the direction of arrow 1 and the crosshead in the direction of the arrow 2, and the reverse lever latch is in the notch marked 6, the valve will close the front steam port when the crosshead edge n has moved 6 inches away from the line o, which was previously marked on the slide; or when the latch is in the notch marked 8 the valve will close the front steam port when the crosshead edge n has moved 8 inches from the line o.

To lay off the notches for the backward motion a similar method is pursued, and the same lines indicating the points of cut-off previously described on the slides, and used for the forward motion of the valve gear, can also now be used for the backward motion. Hence, to lay off the notches for the backward motion, again place the reverse lever H in the center notch, and place the wheel in a position in which the edge j of the crosshead will touch, or nearly so, the line k on the slides. Then turn the driving wheel in a direction opposite to that of arrow 1, and when the edge j of the crosshead touches the line marked 6 on the slide, stop the motion of the wheel, and move the reverse lever H towards the back end of the reverse arc, until the slide valve closes the rear steam port; then mark off on the arc the end of the latch, and thus obtaining the location of the 6-inch notch for the backward motion. In a similar manner the position of all the notches in the backward gear are obtained; and since we have assumed that the valve gear has been correctly designed, it is expected that when the reverse lever latch is in the 6, 8 or 10-inch, etc., notches, steam will also be cut off at 6, 8 or 10 inches, when the crosshead travels in the opposite direction, namely, in the direction of arrow 2. Of course a perfect, equal cut-off is hardly to be expected; that is, when the crosshead moves in the direction of arrow 3 and steam is cut off at 6 inches, it is not to be expected that steam will also be cut off at 6 inches when the crosshead moves in the direction of arrow 2; but we do expect that, as long as the reverse lever latch remains in one notch, the points of cut-off will not vary more than $\frac{1}{4}$ of an inch. If the difference is greater than $\frac{1}{4}$ of an inch, an inaccuracy exists in the fitting up of the valve gear, or it is due to a faulty construction; in either case it should be rectified.

The notches must be correctly located for both cylinders, so that when steam is cut off at 6, 10 inches, etc., in one cylinder, the steam must be cut off at the same points in the other cylinder, or, in other words, both cylinders must receive the same amount of steam. Hence, if we find the notches to be correctly located for one cylinder, we must test their accuracy for the other cylinder; and if, then, we find that one cylinder receives more steam than the other, the cause for this inaccuracy may generally be discovered in the lifting shaft arms, which are out of line; that is, one of the arms may hold the link too high or too low, and, consequently, this arm must be sprung into the proper position, which often is accomplished while the shaft is cold, without taking it out of the engine.

When steam is to be cut off equally without regard to any particular points of cut-off, or full number of inches in the stroke, they are spaced off evenly between the two outside notches and as close together as the strength of the material will allow, and, therefore, generally have $\frac{1}{2}$ of an inch pitch, that is, $\frac{1}{2}$ of an inch from center to center of notch (see thirty-fourth paper). In this case also the same care must be taken to arrange the valve motion in a manner which will supply both cylinders with the same amount of steam.

It should be remembered that the foregoing instructions in setting the valve gear are intended for new work only. When the valve gear for an old engine is to be readjusted, the wear of the different parts must be taken into consideration, which sometimes makes the readjustment a difficult process, and requires experience and a knowledge of the principles connected with the design of the valve motion; these principles we have endeavored to explain and make clear in previous papers.

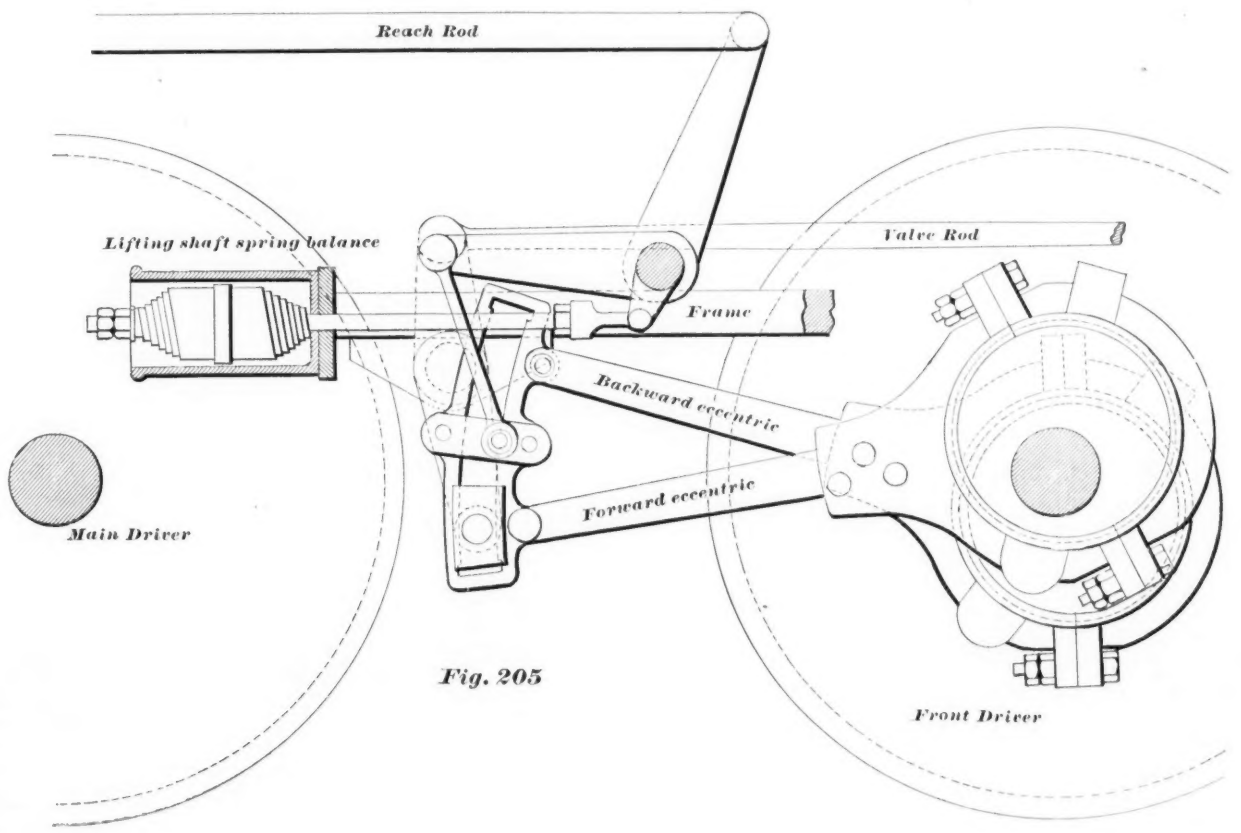


Fig. 205

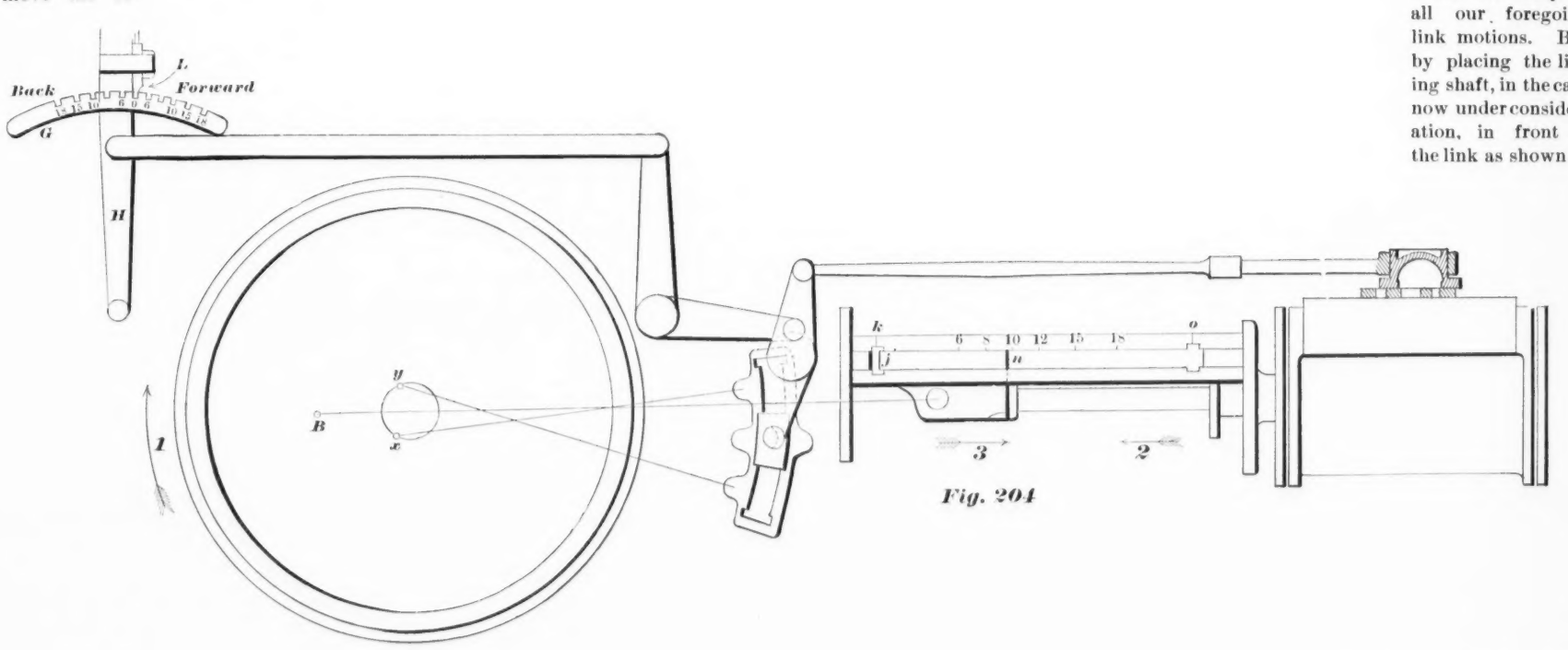


Fig. 204

REMARKS RELATING TO THE VALVE MOTION IN WHICH THE ECCENTRICS ARE NOT ON THE MAIN DRIVING AXLE.

Sometimes it happens that in designing small locomotives the eccentrics cannot be placed on the main axle, consequently we occasionally meet with a valve gear as shown in Fig. 205. In this valve gear the eccentrics are placed on the axle in front of the main axle. Placing the eccentrics on the front axle instead of the main axle will not change the previous rules we have given for designing the valve motion; but it should be noticed that, in order to preserve the lead, no matter in what position the link may be placed, as explained in the thirty-seventh paper, the eccentric rods are connected to the link in a manner which will put the lower end of the link in action when the engine is going ahead, or, in other words, the link must be raised when the engine is to run forward, and lowered when the engine is to run backward. Of course the eccentric rods could be connected to the link so that it would be in the lower position when going ahead and in the upper position when running backward; that is, the link could be made to occupy similar position as in the link motions previously illustrated, and for that matter would also work all right while in full gear, but the lead would be destroyed when the link is placed in any of the intermediate positions for the same reasons as explained in the thirty-seventh paper; and since we must have lead in whatever position the link is placed, we must suspend the link as shown in Fig. 205. It will also be found that in locating the lifting shaft according to the rules previously given the lifting shaft will have to be placed in front of the link, instead of being placed in the rear of the link as has been found necessary in all our foregoing link motions. But by placing the lifting shaft, in the case now under consideration, in front of the link as shown in Fig. 205, we will gain an additional advantage, namely, in connecting the lifting shaft arm to the reverse lever, the latter will be made to point ahead when the engine is going forward—an important fact which should not be neglected or forgotten, because if the valve motion should happen to be arranged in a manner which would cause the reverse lever to point back while the engine is going ahead, the engineer may be thrown in confusion, when, in a case of necessity, the engine has to be quickly reversed, and thus lead to accidents.

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NEW YORK, MAY 28, 1887.

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We are informed that the National Tube Works, of McKeesport, Pa., are making preparations for the manufacture of wrought-iron pipe as large as 24 inches.

American Steam Engine Builders.

We doubt if in any line of manufacturing in the world more universally honest work is done than is done by prominent American steam engine builders. And this is true whether of large engines made only upon orders, or of the smaller sizes held in stock. A man may buy now, as at any time, such kind of an engine as his ability permits or his inclination prompts, and he will find material difference in the same type of engine by different builders; but nineteen times out of twenty he will get good honest work and material.

Another feature of the steam engine trade in this country is the remarkably low prices prevailing. Steam engines were never before sold for so little money. Manufacturers have improved their facilities, frequently under the spur of competition, and have apparently given buyers the entire benefit of their improvements. We venture to say that anyone who has not had occasion to price steam engines during the past ten or fifteen years would be surprised, upon going to the market for one, at the smallness of the price quoted.

It is probably true that prices are too low for the best interests of everybody; but it seems to be a fact that quality has been improved as prices have fallen. This may be, in part, accounted for from the fact that very many more parts are now made in duplicate than formerly, and when work is made in this way, it seems to be true that it is almost invariably better done. But aside from this there has grown up amongst steam engine builders a most commendable pride in the quality of their products. It is much to their credit, if not always to their profit.

Boiler Explosions.

We have at this writing a full dozen of letters giving details of boiler explosions, and in every instance our correspondents show conclusively that these explosions resulted from causes that a very slight inspection would have revealed.

Had these inspections been made it is safe to say that between twenty and thirty lives would have been saved. And these twelve letters cover only a few of the casualties from boiler explosions occurring in the time they cover.

We have refrained from publishing these letters because we could not see that any good would come from their publication, and in some instances harm might come to the writers. All the same we are under obligations to the writers, and can assure them that the facts they have communicated have been of service to us in various ways.

Week before last we gave some account of an explosion at Paterson, N. J. Inexcusable as this explosion was—and there is not an apology of an excuse for it—it was not more so than the great majority of boiler explosions. The true story of boiler explosions almost invariably runs in one of two directions, viz., an old rotten shell the condition of which was unknown, or some cheap John put in charge, with no fitness for the duty except a willingness to work cheap.

With all the facts made plain there is no greater wonder than that there is not an imperative demand for boiler inspection in every State in the country, and an examination of the fitness of those having charge of boilers insisted upon.

In nearly every case of a boiler explosion a trifling cost would have saved the lives of one to three men.

In all seriousness, we think the suggestion we made recently, that the offices should be situated directly over the boiler, would be the best preventive of boiler explosions in the present laxity of all reasonable precautions. If the owners were the only ones exposed to the folly of using boilers unfit for service, controlled by ignorance, it would not be worth while to plead for inspection laws. But unfortunately, as a rule, they are not exposed at all.

Boiler insurance has done a good deal to lessen explosions, yet the principle of insurance is not understood as well as it should be. We heard this exemplified during the past week in a way that would be amusing if it was not something worse. It was the case of a man owning two large boilers. Said he, "I am about tired of paying for insurance on boilers; I have paid regularly for nine years, and there hasn't been an accident from the result of which I could collect a cent; besides this I have been forced to make repairs at a cost of nearly four hundred dollars!" Comment on the above would be quite superfluous.

A bill before the Legislature of New York provides for giving permission to the street railroad companies in New York city to change from horse propulsion to propulsion by cable or electricity. Referring to this, Mayor Hewitt instructs Corporation Counsel Scott to insist that the city of New York shall receive a bonus of one cent on each fare.

The Mayor says: "We are unanimously of the opinion that this bill ought to be opposed in its present shape; but if it can be amended so as to secure to the city of New York a royalty of one cent per passenger for each fare collected, whether upon the main line or upon transfer tickets, we are of opinion that the measure will result in benefit to the city as well as to the companies, and we would, therefore, approve a bill which secures to the city just compensation for the use of the streets."

With all deference to the opinions of the Mayor, we think he is entirely wrong. The street railroads are mainly patronized by workingmen and women, and these pay, directly or indirectly, nine-tenths of the entire taxes of the city. The Mayor's idea is plainly to add a little more to their burden of taxation. If cable or electric propulsion will reduce the cost of carrying passengers, those who ride should receive the benefit of it. The ground which Mayor Hewitt takes is not easily defended on any principle of equity.

We have an inquiry from "Palestine" to which we are unable to give attention, as the State is not named in the letter and does not appear in the postmark. There are only eleven towns by that name in the United States. The writer adds that Palestine newsdealers do not keep the AMERICAN MACHINIST, which would lead us to consider the expediency of inaugurating a crusade in that quarter, if the right Palestine could be discovered. Our arrangements for furnishing the paper through newsdealers all over the country in addition to mail facilities are very complete, and we do not wish "Palestine" to be an exception to the rule.

The process of trade and industrial organization goes steadily on. However it may be with the affairs of the living, it is no new thing with those of the dead, as we note that the Seventh Annual Meeting of the Funeral Directors' Association of the State of Iowa is to be held in Des Moines on May 25, 1887. The president of the Association is Mr. J. B. McCurdy, of Oskaloosa. In addition to the usual routine of such meetings, a lecture on "Embalming, and Practical Demonstration," will form a feature of the programme. Whether arrangements have been made with anybody to shuffle off his mortal coil in the nick of time for this exposition, we are not informed.

Railroad corporations are getting around the pass provision of the Inter-State Commerce bill in a way no doubt satisfactory to their interests so far as newspapers are concerned. They will sell passes, the compensation being the publication of such copy as they will furnish. Not of course in the way of an advertisement, but as pure and unadulterated editorial utterance. The only question is one of what weight such utterances will have.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(233) Three Pupils, Brooklyn, N. Y., asks: Is a fireman on a locomotive engine required to have a license? *A.*—No.

(234) H. D., Charleston, Ill., asks: Is it a good plan to put brass wash-out plugs in a boiler when the plugs are more than two inches diameter? *A.*—Yes.

(235) F. W., Jackson, Mich., asks: What should be the size of an upright boiler to furnish steam for an engine one horse-power? *A.*—It should have not less than fifteen feet heating surface.

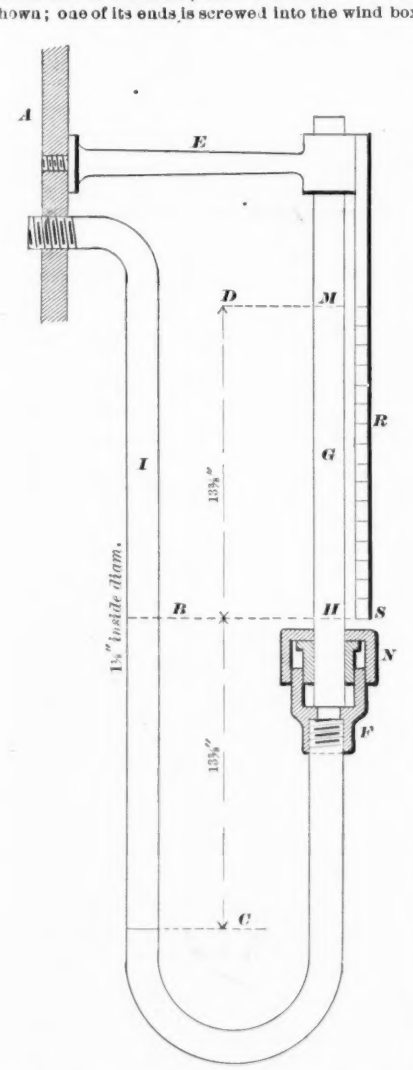
(236) G. B. E., St. Johnsbury, Vt., asks: Are any chemicals or particular fuel used where steel or sheet-iron is used, to give it the uniform blue finish? *A.*—John Coffin, a man of extended experience in iron and steel work, says: "The fuel has no effect on the finish. The requirements are chilled rolls, with polished surfaces, finishing at low heat, and keeping the scale first formed cleanly removed, so that it will not be imbedded in the sheet in spots. To keep the scale removed, jets of water, scrapers, and sometimes bending devices and wire brushes are used. The most important points are the rolls and temperature. A good finish cannot be got on poor iron. Almost all steel takes a good finish. Where thin sheets are rolled in piles only, those piles next to the rolls take a polish. The position of the sheets has to be changed between the passes. I know nothing of stove-pipe iron, however. No chemical is used. I think your correspondent's trouble is with the rolls."

(237) E. E. McC., Barnhart's Mills, Pa., writes: Are there any circumstances under which a person can get more vacuum than the atmospheric pressure? If so, please explain. I am running a pump 14"x20" on two oil wells for the purpose of drawing the gas. I applied a new vacuum gauge made by the Crosby Steam Gauge Company, and it registered a little over 21 pounds. On another well it registered 25 pounds. I am inclined to think the gauge is not right. But why is the gauge graded up to 30 pounds? Please enlighten me and oblige. *A.*—Vacuum gauges are not graded to represent pounds; the marks on the gauges indicate inches, and correspond to the number of inches of mercury in a vacuum which the pressure of the atmosphere will support. It has been found that at the level of the sea the pressure of the atmosphere will support a column of mercury about 30 inches high; and since a cubic inch of mercury will weigh 0.49 pounds, or roughly in round numbers ½ of a pound, it follows that the marks on the gauge which you believe to represent pounds represent only half-pounds. Therefore, the gauges which you mention represented 21 and 25 inches, or roughly 10½ and 12½ pounds. Under no circumstance can the vacuum exceed the atmospheric pressure.

(238) E. M., Wheeling, W. Va., asks: Does it require as much power to drive a 50-inch Sturtevant volume blower, when all the openings are closed, as it does when the full capacity of the blow-pipes are being utilized? Which requires the most power to drive—a volume or a pressure blower? *A.*—We referred these questions to Mr. B. F. Sturtevant, and also to the Buffalo Forge Company, of Buffalo, N. Y. Mr. Sturtevant replies as follows: "It does not require as much power to drive a 50" Sturtevant volume blower or a 50" steel-plate exhausting fan, as we term it, when all the openings are closed, as it does when the full capacity of the blow-pipes are being utilized. The work performed by any machine is always a measure of the amount of power consumed to do the work, and the more work that any machine does the more power it requires. By closing the openings, either in the inlet or outlet pipe, of an exhaust fan or fan-blower, the capacity of the machine for moving air is restricted, and consequently there is a reduction in the amount of power consumed. For this reason, we always recommend that blast gates be placed in the pipes attached to our machines, not so much that the force of suction may be increased at other points—for this cannot be done to any great extent in a properly-arranged system of piping by simply closing the gates at other points—but that power may be saved. It is immaterial whether this reduction of openings in the pipe is effected in the inlet pipe or the outlet pipe; the effect produced is the same, and generally speaking the amount of power consumed by a fan-blower or exhausting fan decreases as the openings through which it takes in or expels air are decreased. There are many conditions which would have to be considered in the full discussion of this subject which you probably do not care for, and which we have not time to enter into at this writing, but what we have said above we think fully covers the subject in a rough manner. In answer to your second question, which asks, 'Which requires the most power to drive—a volume blower

or a pressure blower?' we have to say that the amount of power consumed by a blower depends upon the diameter of the wheel, the width of the wheel at its inlet and its outlet, and the velocity with which the wheel is traveling. Our steel pressure blowers are quite narrow at both inlet and outlet of the wheel, and travel at high velocities, producing pressures ranging as high as one pound to the square inch. Our volume blowers have wheels which are much wider at inlet and outlet than are the pressure blower wheels, and travel at low velocities compared to the speed given to the pressure blower wheels. Generally speaking, the pressure blower usually requires more power than a volume blower of the same size—*i. e.*, height of shell—for the reason that the wheel is speeded for its work at a much higher velocity than is the volume blower wheel. If the two wheels were to be given the same velocity of periphery, the volume blower would take the most power, for the reason that the wheel is much wider, and would consequently move much more air, necessarily consuming much more power. You will readily see that in some cases the volume blower would consume more power than the pressure blower, while at other times the reverse would be the case. It is entirely a question of velocity of periphery and width of wheel." We have also received a similar reply from the Buffalo Forge Company, of Buffalo, N. Y.

(239) C. C. G., Houlton, Me., writes: I wish to make a blast pressure gauge, as illustrated on page 317 in American Foundry Practice, by T. D. West. I do not understand by his description on page 323 the proportions; how high a column of water will one pound of pressure support? Please give full directions how to make one. *A.*—For all practical purposes, it may be assumed that 1 cubic inch of water will weigh .576 oz.; consequently a column of water 1 inch square, whose weight is 1 pound, must be 27.7 inches high, or, say, 27¾ inches high If we take a wrought-iron pipe 1½ inch inside diameter, its area will be .994 square inch, which is so near to 1 inch that we may neglect the difference and say its area is 1 inch square. In order to show how to graduate a pressure gauge, let us assume that we have made a gauge as shown in the figure, but which has not yet been graduated. *I* is a wrought-iron pipe 1½ inches inside diameter, both of its ends bent as shown; one of its ends is screwed into the wind box



A, and to its other end a stuffing-box *F* is screwed; in this stuffing-box a glass tube *G* is placed, whose inside diameter is also 1½ inch. The stuffing-box nut *N* is screwed down so as to prevent the leakage of any water. *E* is simply a support to hold the glass tube in position. Now, in order to graduate the tube, draw a line *H* on the glass tube about 1 inch above the top of the nut *N*, and then through the upper end of the glass tube pour some water until the water just reaches the line *H*. Then procure exactly 1 pound of water, and pour this also into the glass tube; this will rise to about 13⅝ inches above the line *H*; mark this height by drawing the line *M* on the glass tube; lay off the distance from *H* to *M* on a rod *R*, to be used as a graduating scale, and divide this distance into 16 equal parts, and fasten this scale to the support *E*, so that the lower end *S* of the scale will be even with the line *H* on the glass tube. Now pour out the water, and refill the gauge until the water reaches the line *H*, or what will amount to the same thing, the bottom end *S* of the scale. The gauge is now ready for use. When the water is at *H*, it indicates that there is no pressure in the wind-box; when the pressure in the box forces the water up to the first line of division on the scale, it indicates that there is 1 ounce of pressure in the wind-box; the next mark indicates 2 ounces of pressure, and so on; and when the pressure forces the water up to *M*, there is 1 pound pressure in the box. When the water has risen to *M*, the distance between the water level *D* and *C* will be 27¾, and the wrought-iron pipe *I*, between the line *C* and *D*, should be perfectly straight and stand vertically; also the glass tube and that portion of the iron pipe from the bottom of glass tube to the line *C* should form a straight, vertical column of water. Now, in order to make a pressure scale whose iron pipe and glass tube are smaller in diameter than 1½ inches, we believe the following method of making it will be the cheapest and best: Select an iron pipe *I* and a glass tube *G*; the inside diameter of one must be exactly equal to that of the other. Bend the ends of the iron pipe *I*, as shown in the figure, and leave a portion of the pipe—that is, from *C* to D, equal to 27¾ inches—perfectly straight. Screw one end of the pipe into the wind-box *A*, and to its other end screw the stuffing-box *F*; insert the glass tube, place some hemp packing around its lower end, and screw down the nut *N*. Fasten the scale *R* to the support *E*, so that the end *S* of the scale will not interfere with unscrewing the nut *N*. It may be remarked here that the distance from *H* to *M* on the scale remains the same so long as the inside diameter of the iron pipe is equal to the inside diameter of the glass tube, no matter whether these diameters are greater or less than 1½ inch. Now fill the gauge until the water reaches the bottom end *S* of the scale; then the scale is completed and ready for use. This gauge may be made throughout of one glass tube, but we believe one made as shown in the figure will give better satisfaction.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Geo. B. Grant's adv., p. 16.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st, N. Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., N Y

Exhaust Tumbl'g Bbls. Henderson B's., Waterb'y, Ct.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

Models, Drawings and Special Machinery. G. F. Haven, 211 Mulberry st., Newark, N. J.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Robbs' Patent Composition for case-hardening. Send for circular. F. W. Tasney, Paterson, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Extra capacity, hollow-spindle Hand Lathes; correspondence solicited. J. R. Rand, Brattleboro, Vt.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N Y

20", 25", 28" B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 124 built, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Complete sets of Castings for making small and medium-sized vertical engines; send for prices. Humphrey's Foundry, Bellefontaine, Ohio.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See May 21, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Patents, American and Foreign, promptly procured and sold on best terms by Jas. H. Lancaster, patent attorney, 187 Broadway, N. Y., and London.

Small Machine Shop Plant for sale; best of tools up to 50"; building can be rented low. Address Chs. W. Griggs, Dearborn and Monroe sts., Chicago, Ill.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

New Book on Gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price 50 cts. Address C. B. Long, M. E., Worcester, Mass.

Catalogue of Books on Mechanical Engineering, Electricity, Arts, Trades and Manufactures, 116 pages, and monthly list of latest books, free of charge; can supply any book at published price. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

Hiawatha, Kan., is to have an electric light plant.

The Elkton (Md.) Machine Works are to be enlarged.

A large shoe factory is to be established at Hallowell, Me.

A steam grist mill will be built at Mechanic Falls, Me.

The Chattanooga (Tenn.) Wood Split Pulley Company is a new enterprise.

The Vanderkloot Iron Works, of Chicago, Ill., are looking for a location elsewhere.

The Southern Tool Company, St. Louis, Mo., are looking for a location elsewhere.

The Merrick Thread Company, of Holyoke, Mass., expect to build another large mill.

Dodge, Davis & Co., Bristol, N. H., will erect a large addition to their woolen mill.

It is proposed to establish a new shoe manufacturing company at Florence, Mass.

There are good prospects for the erection of a large woolen mill at Hartland, Me.

A shirt factory and steam laundry is to be erected at Nashville, Tenn., by G. M. Adams.

Birmingham, Ala., is to have a sad-iron manufactory, with a capacity of ten tons a day.

Whitmore & Summers are to rebuild their saw mill, recently burned, at Judsonia, Ark.

J. J. Spilker, Cincinnati, Ohio, has brought out a new miter box, adjustable to all angles.

The Elyton Land Company will build a blast furnace and rolling mill at Birmingham, Ala.

The Hamilton Woolen Company, Southbridge, Mass., will materially increase their works.

An addition to the spinning mill of the Lowell (Mass.) Manufacturing Company is to be made.

A company, to be known as the St. Paul Knitting Works, will erect a large factory at St. Paul, Minn.

Additional machinery will be put in at N. T. Hill's extension-table manufactory at Portland, Me.

The Talladega (Ala.) Land and Improvement Company are to build a sash, door and blind factory.

The citizens of Marion, Kan., offer a bonus to any firm who will start a foundry there to employ 100 men.

It is rumored that a large cotton factory is to be built at Louisville, Ky., by J. M. Atherton and others.

A rice mill, oil mill and cotton press are to be built at Opelousas, La., by Joseph Block and others.

Repair shops will be built at Chattanooga, Tenn., by the Chattanooga, Rome and Carrollton Railroad.

A new company has been organized to manufacture stockings at Lowell, Mass. J. A. Burleigh is superintendent.

The Duck River Valley Railroad Company will remove their repair shops from Columbia to Fayetteville, Tenn.

The G. F. Holt Machine Company, Boston, Mass., manufacture the Baxter engine, and have an increasing demand.

The Girard (Kan.) Foundry and Machine Company has begun the erection of a building, 40x170 feet, two stories high.

The St. Louis (Mo.) Iron and Machine Works recently made a casting for the City Water Works that weighed 45,000 lbs.

A lumber and shingle mill is to be built at Plaquemine, La., by the A. Withbert's Sons' Lumber and Shingle Company.

The Cochecho Print Works, Dover, N. H., destroyed by fire, is now being rebuilt, the work being pushed rapidly to completion.

The stockholders of the Seaconnet Mill, Fall River, Mass., have voted to increase the capital stock from $300,000 to $400,000.

The Muller Machine Tool Company, Cincinnati, Ohio, have removed to their new shops, where they have largely increased facilities.

A factory for the manufacture of iron bridges, bolts, nuts, etc., is to be built at Rome, Ga. W. G. Wetty, Cleveland, Ohio, is interested.

The Estey Piano and Organ Company will erect a brick factory on the north side of the Southern boulevard, New York, near Lincoln avenue.

There has been a consolidation of the gas companies and the electric light companies in Chicago, Ill. New electric light stations will be put in.

A co-operative company, known as the Schaus Manufacturing Company, has gone into operation at Toledo, Ohio. All kinds of furniture will be manufactured.

A consolidation has been effected between the Sloss Steel and Iron Company and twe Coalburg Coal and Coke Company, at Birmingham, Ala. Capital stock, $400,000.

The city of Albany, N. Y., proposes to put in a new pumping engine of about 15,000,000 gallons' capacity. There is also a proposition to put in a 10,000,000-gallon engine at Troy, N. Y.

The Chattanooga (Tenn.) Tool Company will at once begin the erection of a building 60x150 feet, two stories high. They will manufacture hoes, rakes, and a variety of agricultural implements.

James E. Hotchkiss, lately removed to 120 Liberty street, New York, has got out a new edition of his pamphlet, "How to Keep Boilers Clean," which will be mailed to any address for one cent postage.

Butterfield & Co., Derby Line, Vt., are manufacturing the Youngs axle cutter, which is designed for sharpening the arms of axles after they become worn; also stocks and dies for blacksmiths and machinists.

Thomas Pray, Jr., has opened an office at No. 31 Milk street, Room 42, Boston, where he will act as consulting engineer, with special reference to supplying incandescent electric light plants on the Mather system.

The Pittsburgh Traction Company, with a capital stock of $2,500,000, will construct a cable street railway along Fifth avenue, from the lower part of the city to the East End. The permanent way will all be iron and steel, imbedded in concrete. The cable will be one and three-eighths inches and of steel wire.

Hill, Clarke & Co., Boston, Mass., inform us that they have the contract for the machine tools and outfits for the Southern Oil Company, for their machine shops at Houston, Tex.; Little Rock, Ark.; Memphis, Tenn.; New Orleans, La.; Montgomery, Ala.; Atlanta, Ga.; Savannah, Ga.; and Wilmington, N. C. These outfits provide for making all repairs at each of their mills.

A press dispatch says: "The Roane Iron Company began operations in this city May 7 with its steel mill. It is the largest Bessemer steel plant ever built in the South, the investment representing $1,000,000. It starts with a capacity of 250 tons of steel per day, and employs over 600 hands. Two Bessemer steel mills are now in operation at Chattanooga, the only ones in the South."

The stockholders of the Globe Yarn Mills, Fall River, April 28, voted to build a new yarn mill on the Bay street property recently purchased, and to increase the capital stock from $300,000 to $600,000. The new mill will probably cost $275,000. It is intended to erect a mill of from 20,000 to 25,000 spindles to manufacture yarns for the hosiery trade.—*Boston Journal of Commerce.*

Pond Engineering Company, St. Louis, Mo., send us a copy of their 1887 catalogue of machinery sold by them, including engines, boilers, grate bars, Lowe feed-water heaters, Hyatt filters, Blake pumps, injectors, Mason regulators, Jenkins' valves, and other steam specialties. They also give a list of mechanical books as issued by various publishers, for the sale of which they have opened a book department.

Geo. Fullers' Sons, at their foundry and machine shop in Hallowell, Me., employ 25 hands through the year. Their machine shop is now running on general mill repairs. They make a specialty of machine castings, and do a large amount of job casting in their foundry. In the wood department several hands are constantly employed in the manufacture of print blocks for oilcloth carpets. These goods are found in nearly every oilcloth carpet factory in this country and Canada.—*The Industrial Journal.*

Wm. L. Coop, 47 Sprague street, Providence, R. I., sends us a moving appeal on behalf of the Y. M. C. A. drawing classes, now being conducted in that city. The Y. M. C. A. wants a building. A site has been purchased, corner Westminster and Jackson streets, and $140,000 has so far been subscribed, $150,000 being the aim. If all the parties seeking subscriptions and helping along the work of the institution are as indefatigable as Mr. Coop, they will be liable to raise a million.

The Prentiss Vise Company, 23 Dey street, New York, have issued, under date May, 1887, a new illustrated price-list, which supersedes all previous lists. They have adopted the use of numbers by which to hereafter designate both the sizes and kinds of all their vises. They have lately put a new solid jaw heavy chipping vise on the market, with 8½-inch jaws and opening 12 inches. Weight, 275 lbs. Also a "rapid transit" parallel vise in several styles, for the use of machinists and woodworkers, with and without swivel bottom attachment.

Machinists' Supplies and Iron.

NEW YORK, May 12, 1887.

There is neither a boom nor depression in manufacturing or the supply trade; in fact, it is difficult to note, from week to week, any difference whatever in trade. It is, however, a fact that those who watch the course of trade carefully say there is gradual improvement.

Iron—There is but little life in American pig. Buyers seem to have settled down to a belief that prices will not be higher, and it is equally true that sellers are determined to keep up prices. Standard brands of No. 1 X Foundry sell at $21 to $21.50; No. 2 X, $19 50 to $20.50; Grey Forge, $18 to $18.50.

Scotch Pig—Transactions have been slightly more active, though far from lively. With present prices in Glasgow, it is not likely that lower figures will be quoted here. Coltness sells at $22 to $22.50; Gartsherrie, $21.50 to $22; Summerlee, $21.50 to $22; Eglinton, $20.50; Langloan, $21 to $21.50; Dalmellington, $20.50 to $21.

Antimony—Hallett's, 7.45c.; Cookson's, 8⅞c.

Copper—There is but little activity in the market, Lake has been offered at 10c., but bids are a trifle less.

Lead—Some sales have been made at 4.50c., but bids are scarcely higher than 4.45c.

Spelter—Refined, 5¾c. to 6c.

Tin—Prices have advanced. Banca has sold at 23¾c.; Straits and Malacca, 23.15c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Leading position by first-class draftsman. Address Box X, AM. MACHINIST.

An experienced mechanical draftsman wants position. Address L. M. N., AM. MACHINIST.

Six first-class machinists on engine work; steady employment given. Address Ottumwa Iron Wks., Ottumwa, Iowa.

A man with theoret. and practical experience wishes situation as designer or foreman of drawing room. Address M. E., AM. MACHINIST.

Position as foreman boilermaker by man thoroughly competent; has been foreman several years; best references. Address Box 32, AM. MACH.

Wanted—Situation as foreman of machine shop; experienced in building automatic engines, etc.; first-class references. Address High Pressure, AM. MACHINIST.

A 1 tool maker wishes to change position; is also good draftsman, and capable of taking charge; well up in approved and modern methods. Address Box 34, AM. MACHINIST.

Wanted—A skillful and active machinist for special work; a young man preferred; the right person will have a chance to rise. Inquire S. R. Krom, 151 Cedar st. N. Y.

A mechanical engineer and superintendent of long experience with steam and hydraulics, and general heavy machine work, is open for engagement; satisfactory references. Address D. E. H., AM. MACHINIST.

A thorough machinist wants position as foreman of machine shop; thoroughly experienced on engines, general and special machinery, on shop and outside work, and on modern machine shop practice; 15 years' experience; reliable references. Address Skillful, AM. MACHINIST.

Wanted—As asst. superintendent, a situation by a young man whose education and experience in mechanical trades and in business matters makes him thoroughly competent to fill a responsible place; refers to leading manufacturers and prominent men as to character and ability. Address Asst. Supt, P. O. Box 672, New York city.

Machine shop foreman wanted to go South, accustomed to stationary engine work, general jobbing and steam fitting; must understand handling men to the best advantage, and be well advanced in modern machine shop practice; state wages expected and where last employed. Address Enterprise, AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

For Sale—Low figure, in good order, four stationary engines—one each of thrty-five, forty, fifty and sixty horse-power. Address Pratt & Letchworth, Buffalo, N. Y.

Designs and working drawings prepared for every branch of mech. engineering; pumping machinery a specialty. A. C. Christensen, 26 Church st., N.Y. (late chief draftsman for Henry R. Worthington).

Would like to arrange with some enterprising firm to manufacture on royalty, a high-pressure centrifugal pump adapted to water supply for cities and towns; will reduce the cost of pumping plants nearly one-half. Address Water Supply, AM. MACHINIST.

To Manufacturers—Desirable water-powers, with permanent dams and buildings, in a thriving, prosperous village, with good R.R. connections, to be had on most favorable terms; special inducements to reliable parties desiring to locate. Address J. W. Hall, Sec'y Business Association, Cazenovia, N. Y.

Wanted—Superintendent or manager, who has ten to fifteen thousand dollars to invest, to take position in our established fdy. and mch. shops, now doing a nice business and located in New York State: must be able to handle men, and capable of influencing work to increase business; extra inducements offered to the right man. Address Business, AM. MACHINIST.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.

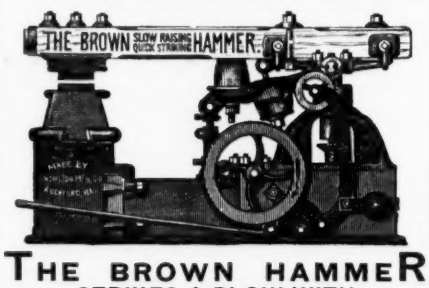
For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

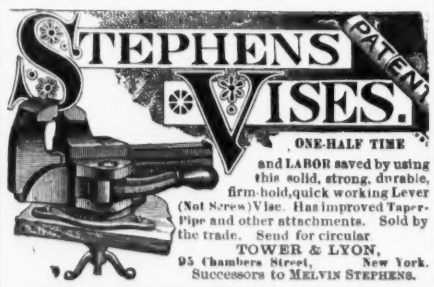
Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

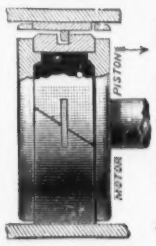
BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER
STRIKES A BLOW WITH
Double the Velocity That it Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., KING ST., ROCKFORD, ILL.



ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.
TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.



Brandon's Piston Ring Packing

Perfectly balanced against undue pressure in all directions. Preserves both cylinder and rings. Allows no waste by either friction or leakage. Call and see working model, expressly made to demonstrate advantages claimed. For packing or shop rights, address

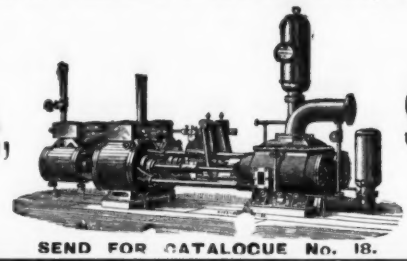
JAMES BRANDON,
390 Eleventh Ave., New York.

93 Liberty St. NEW YORK. | 113 Federal St., BOSTON.

IMPROVED PUMPING MACHINERY | For Every Class of Work | SEND FOR NEW ILLUSTRATED CATALOGUE.

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works, ENGINES AND Steam Pumping MACHINERY.



SEND FOR CATALOGUE No. 18.

TRAVERSE SHAPERS.

15 inch stroke x 27 inch Traverse.
20 " " x 60 " "
30 " " x 72 " "

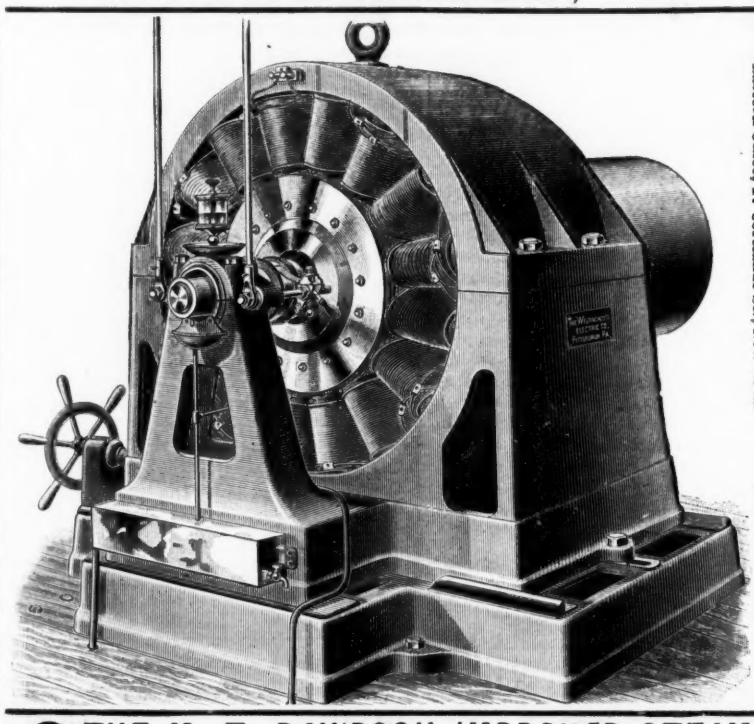
As noted above, we build 3 sizes of Traverse Shapers and can make the beds any desired length to suit special work. They are all stiff solid tools with a very deep bed. The two larger sizes have each 2 tables, a large heavy graduated swivel vise and automatic, vertical, angular and horizontal feed. The circular arbor also has independent feed. Screws and shafts are of steel and bearings are of hard bronze. The rack gear and pinion and other small gears are of steel. Our illustrated catalogue gives full description, and we shall be pleased to send them to those who are interested.

THE HENDEY MACHINE CO., TORRINGTON, CONN.

THE ALTERNATING SYSTEM.

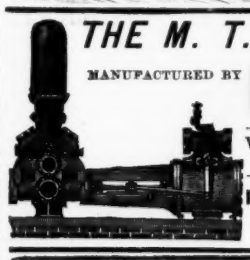
THE WESTINGHOUSE ELECTRIC CO.

Eastern Office, 17 Cortlandt St., New York. PITTSBURGH, PA.



THE M. T. DAVIDSON IMPROVED STEAM PUMP,

MANUFACTURED BY DAVIDSON STEAM PUMP COMPANY.



WARRANTED THE BEST PUMP MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

GUILD & GARRISON,
BROOKLYN, N. Y
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
SEND FOR CATALOGUE.

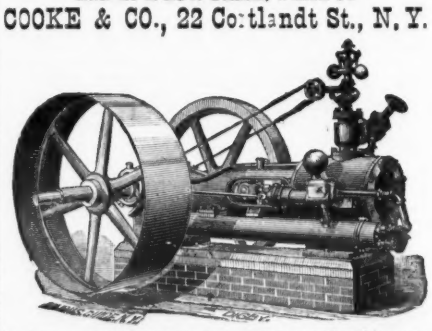
SEBASTIAN, MAY & CO.'S
Improved Screw Cutting
FOOT or POWER LATHES.

Catalogue of Lathes, Drill Presses and Machinists Tools and Supplies mailed on application. *Lathes on Trial.*
167 W. Second St., CINCINNATI, O.

OIL CUPS

For Engines, Shafting, &c.
Illustrated Catalogue Free.
J. E. LONERGAN & CO.
Philadelphia, Penna.

IF YOU WANT A STRONG, ECONOMICAL
ENGINE
EITHER HORIZONTAL OR VERTICAL,
FOR STEADY EVERY DAY AND ALL NIGHT SERVICE, AND AT A LOW PRICE, WRITE TO
COOKE & CO., 22 Cortlandt St., N. Y.



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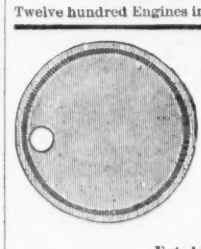

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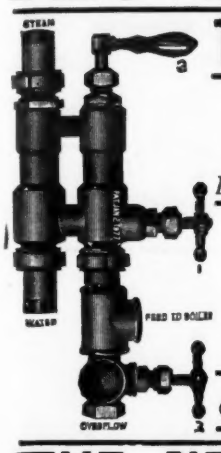

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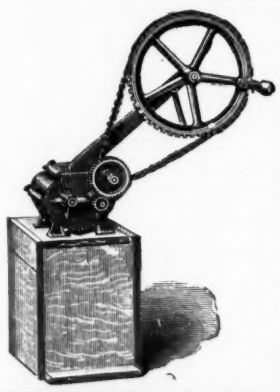

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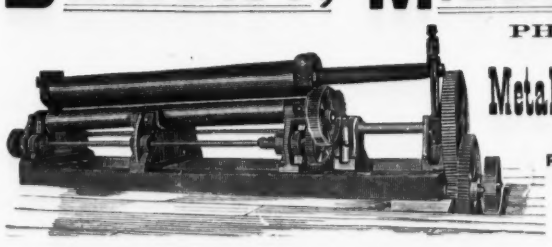

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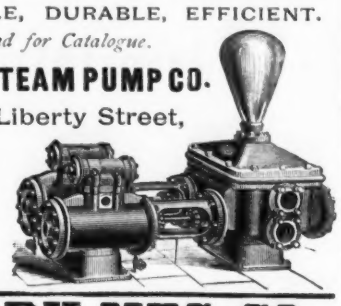

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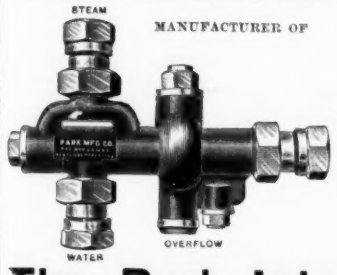

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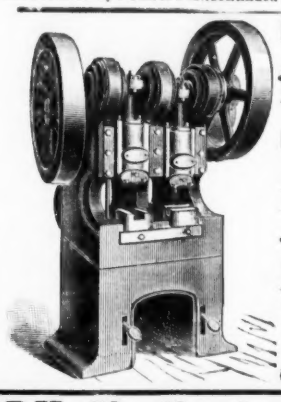

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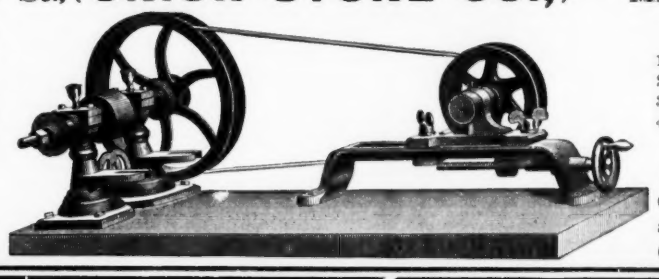

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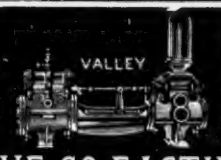

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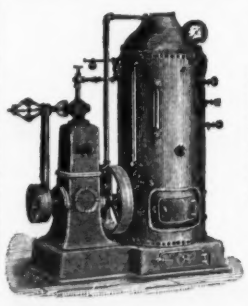

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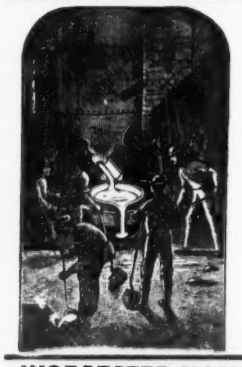

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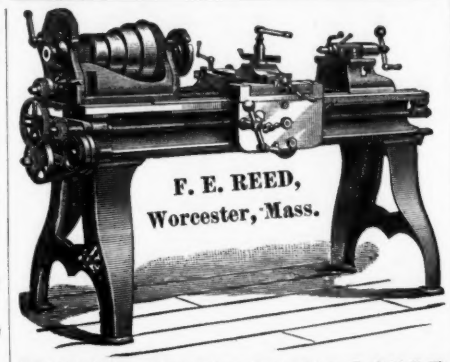

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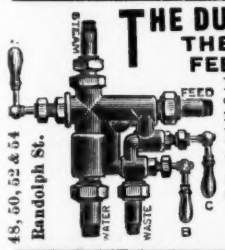

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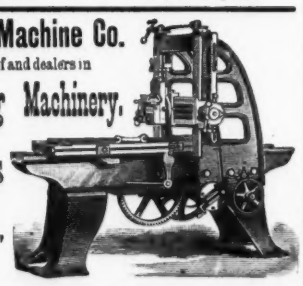

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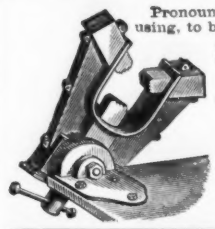

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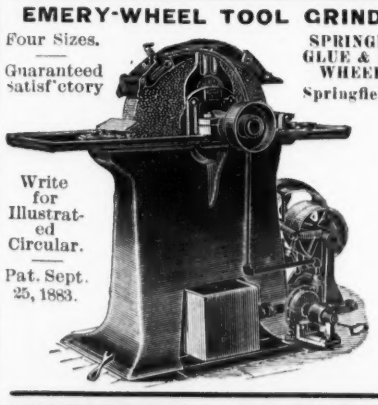

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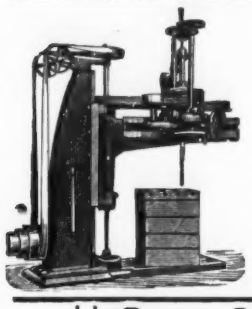

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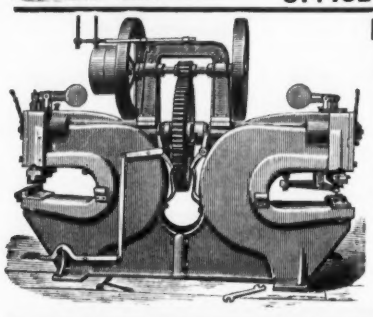

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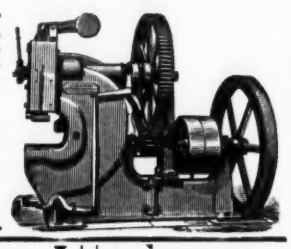

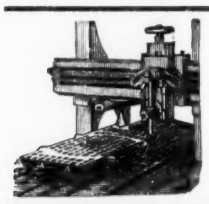

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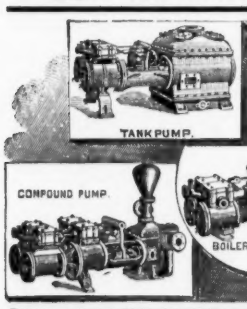

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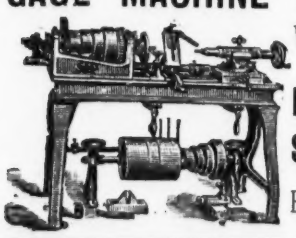

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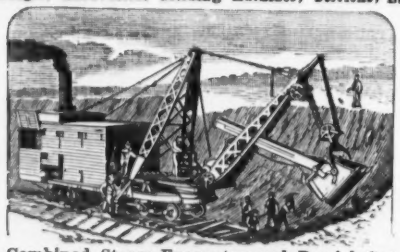

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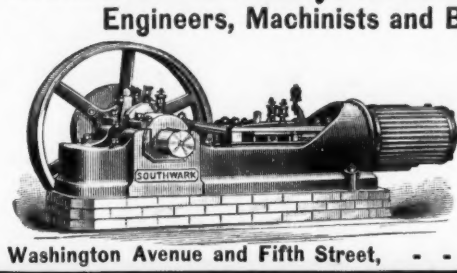

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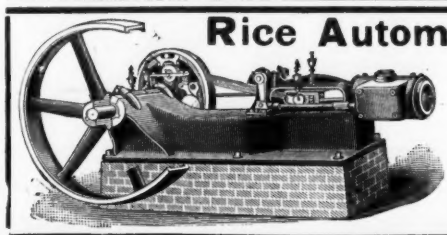

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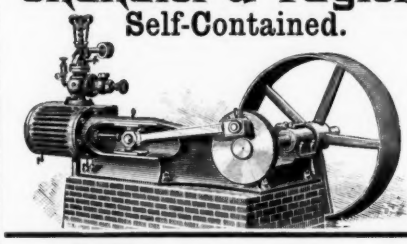

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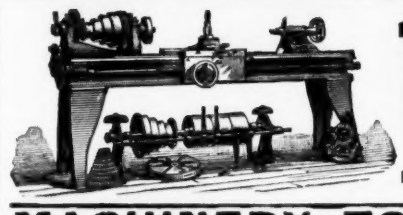

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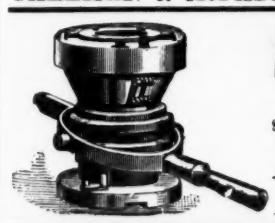

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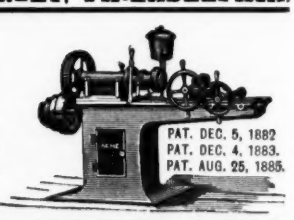

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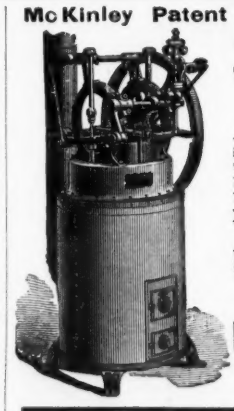

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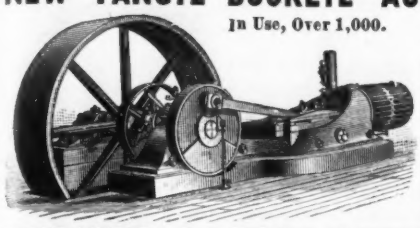

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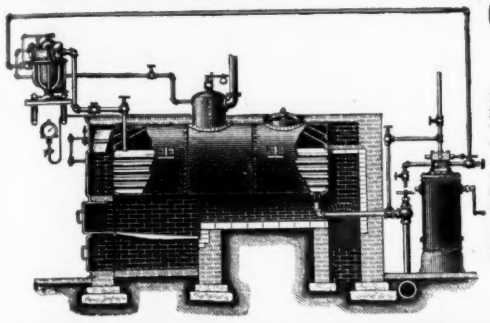

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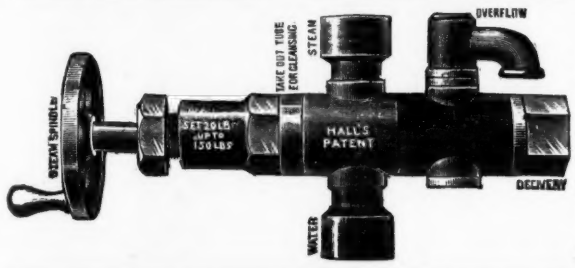

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We make no charge for extras. Every lathe is furnished with *hollow spindle*, the 19" with 1⅛" hole, and 21" with 1⅜" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½" down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gunmetal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

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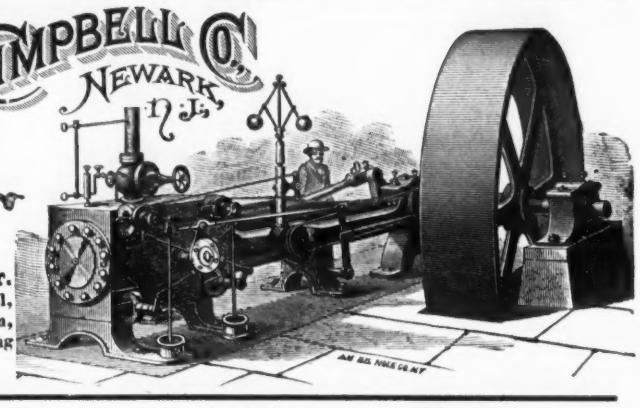

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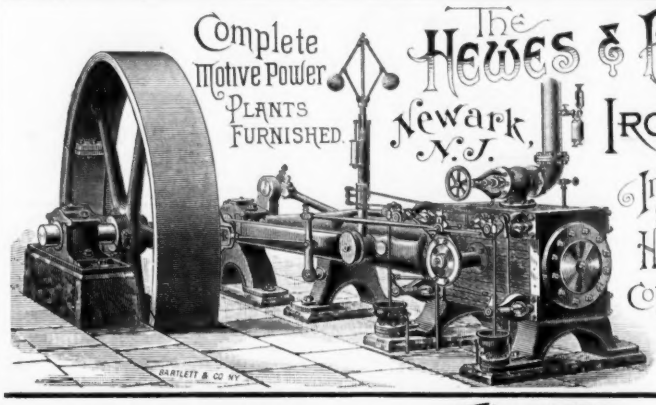

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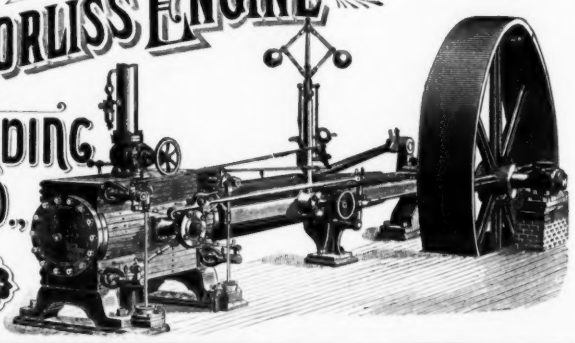

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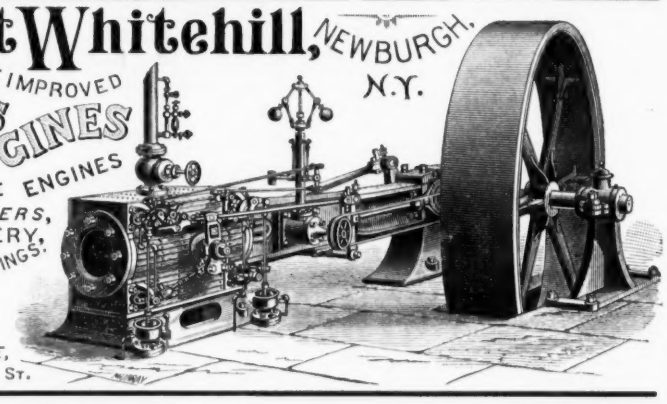

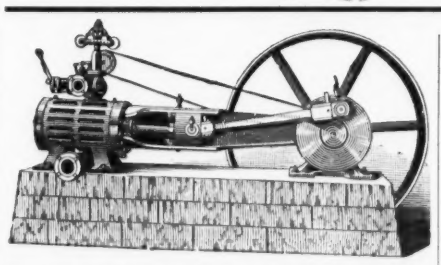

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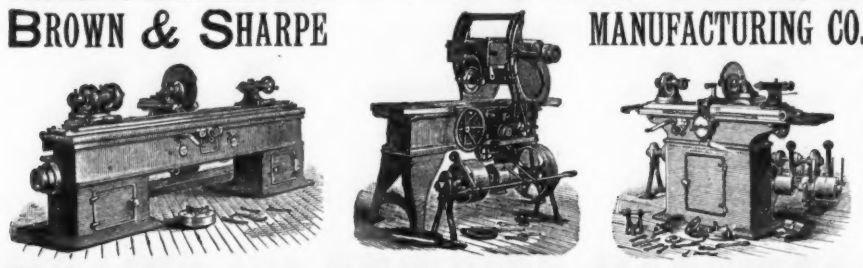

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Very truly yours, **W. McGREGOR & CO**

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(See special notice of Engine Lathes on page 15.)

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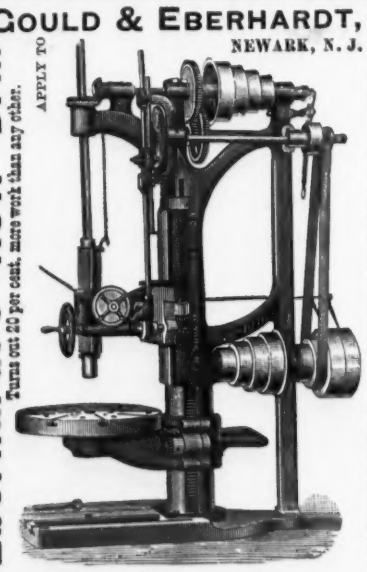

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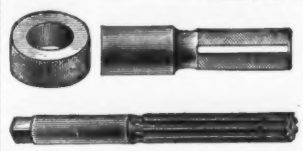

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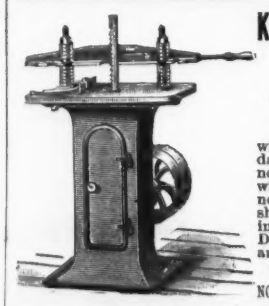

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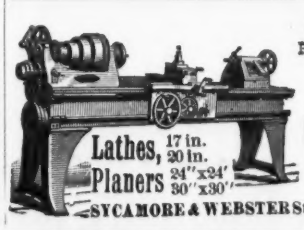

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